

JOURNAL
OF THE
BOMBAY NATURAL
HISTORY SOCIETY

1971 DECEMBER

Vol. 68

No. 3

An ecological Survey of the larger
Mammals of Peninsular India

BY

M. KRISHNAN

(*With eight plates*)

INTRODUCTION

THIS report is based on many years of observation in a great many faunal areas widely distributed over peninsular India. Some of the work was planned, sustained and intensive, the rest of it sporadic and done as opportunity offered. The report is documented by 242 photographs selected from several thousands taken over 12 years, from 1959 to October 1970, and is largely supported by the field notes written up each day during this period (which are appended to the report) and personal experience.

This general statement needs amplification both to indicate adequately the factual records of the report and to expose their limitations. While a considerable body of record (observation notes and photographs) prior to 1959 is available, it was decided to make that year the starting point of this survey, because it was only from then on that photography was regularly employed as part of the field work to supplement and complement observation. The value of photographic documentation (briefly set out in the section on photography, later here) was realised much earlier, but it took years to build the cameras I needed for the work and to develop an adequately versatile photographic technique, largely owing to personal limitations.

All field trips prior to 1959 have been left out of the records of this survey. Many field trips made during the first 10 years of the 12-year period have also been left out because they were to faunal areas outside the region of peninsular India (though a few relevant extracts from trips

to the Jaldapara sanctuary of West Bengal, the Kaziranga and Manas sanctuaries of Assam, and the Corbett National Park and the Dudwa preserve of Uttar Pradesh have been included), or because they were mainly floristic or photographic trips, or else because it was not possible to revisit those areas for a check on earlier observation during the last 2 years when intensive work was done on the Jawaharlal Nehru Fellowship. The field notes appended¹ provide full details of the areas visited, the duration of each visit, and seasonal and other particulars. Brief accounts of the terrain and main floristic features of the Periyar, Mudumalai, Point Calimere, Bandipur, Kawal, Hazaribagh and Palamau sanctuaries have been provided later in this report. As far as possible, during the last 2 years, two visits were made at the same time of the year to areas already visited earlier and to new faunal areas. The study locations, in 8 States, are listed below (full details will be found in the field notes and photographs): Kerala: the Periyar Sanctuary (and one isolated record from Quilon); Tamil Nadu: the Mudumalai Sanctuary (which was intensively worked, over years) and the Point Calimere Sanctuary (and selected records from Guindy Park in Madras, Topslip in the Anamalais, and Sholinghur); Mysore: the Bandipur Sanctuary (and one isolated record from the Ranganathittoo Sanctuary); Andhra Pradesh: the Kawal Sanctuary (and passing references to the Pakhal and Eturunagaram Sanctuaries); Orissa: Balimela, Chilka and surroundings, Tickerpara and surroundings, the Usha Kothi Sanctuary in Badrama and the Raigoda Sanctuary, and the Simlipal hills; Bihar: the Hazaribagh and Palamau National Parks, with brief visits to the Baresand area, Tholkobad and Karkatnagar; Madhya Pradesh: the Kanha National Park, with brief visits to Churna (Bori), the Shivpuri National Park, Bastar and Bara Naya Para; Maharashtra: the Taroba National Park.

Some important areas with a distinctive fauna, like Gujarat and Rajasthan, were not visited at all. It was not possible to do so because, during the last 2 years when intensive work could be done, it was decided to do it in areas already known and contiguous tracts so as to obtain reliable records from a series of sample surveys, rather than to break new ground.

ACKNOWLEDGEMENTS

The grant of a Fellowship for an ecological mammalian survey of peninsular India, by the Jawaharlal Nehru Memorial Fund, enabled me to bring my work until October 1968 to some shape by sustained and continuous field work and photography over the next 2 years, and to complete this report. It was a real privilege to be trusted so entirely to

¹ The field notes are omitted in this publication for reasons of space. However, these notes are available in typescript with the Bombay Natural History Society, and are being held by the Society.

plan and execute an ambitious project. My thanks are also due to the Bombay Natural History Society for suggesting that I might be entrusted with this survey. I can only hope that this report is, in some measure, worthy of the trust reposed in me by the Jawaharlal Nehru Memorial Fund and the Bombay Natural History Society.

It is with pleasure and thankfulness that I acknowledge the generosity of the Governments and Forest Departments of Kerala, Tamil Nadu, Mysore, Andhra Pradesh, Orissa, Bihar, Madhya Pradesh and Maharashtra in providing me with all facilities for work in their forests. Members of the Forest Departments of these States, at all levels, have helped with local guidance and advice, and in other ways, and I am grateful to them for help received.

To my brother professional photographers in Madras and other friends who have responded so unfailingly to my usually exacting and invariably urgent calls upon their time and skills over the past 12 years, I owe such a polymorphic debt that I can only record my thankfulness to them all here generally. However, I am specially indebted to K. Krishna-moorthy, Conservator of Forests, Kerala (now retired) and to Dr. B. G. L. Swamy, Chief Professor of Botany, the Presidency College, Madras, for identifying plants for me and for discussions of forest ecology in India; to B. V. Sessaiah, ace-photographer, for discussions of ways and means for extending the frontiers of photography to suit my field work; to V. H. Sivamani Nadhan and K. Mani for technical help and advice in the devising of my photographic equipment; and to C. Gowrishankar and K. Krishna Murari Rao for aid in many ways. I also acknowledge help received from my son, M. Harikrishnan of the Indian Forest Service, with floral identifications, floristics and stray faunal observations, and am indebted to my wife, Indumati Krishnan, for much help with the typescripts.

THE PHOTOGRAPHIC RECORD

The main value of a clear photograph in supplementing and complementing visual observation in the field is that the camera's vision is comprehensive and unbiased. Many particulars that the eye might miss for various reasons, such as the confusion resulting from the movement of a number of animals in bush cover, or by the eye being preoccupied with some displayed feature or action of the subject to the exclusion of less flagrant details, are recorded unselectively by the camera, so that study of a clear enlargement of the photograph often reveals details that the observer might have missed. This truth is widely recognised in the copying of documents by photography to ensure total fidelity, but insufficiently appreciated in faunal field work. However, for worthwhile photographic records of wild animals it is necessary that the subject should be truly wild and free—or, to put it in photographic parlance,

that the record should be candid. It is conceded generally by students of animal behaviour that the responses and behaviour of wild animals in captivity and in contrived situations are often misleading.

Two practical photographic difficulties arise from this. Obviously, the photographer-cum-observer has his best opportunity when his presence is undisclosed to his subject, as when he is in a hide. Early experiments with ground-hides and more portable camouflage soon exposed their limitations. Apart from the lack of mobility which they inevitably involve, they have major set-backs when employed for the observation of mammals in Indian forests, excellent as they are for bird photography. Most forest mammals depend even more upon smell than on sight, and frequently the photographer inside a ground-hide is discovered by his subject even before he is aware of its proximity, and thereafter naturally never gets even a glimpse of it. Worse still, in elephant country such hides can prove quite dangerous, as I can attest from personal experience. Tree-seats and machans, sited high enough for the human occupant's smell to pass above the animals' questing nose, are much more useful, especially as they can give the watcher a good, overall view, but they are easily detected visually. However, some work was done from such elevated stances.

With free-ranging animals like gaur, deer and predators, it is often possible, when the initial approach has been displayed and casual from a sufficient distance, and has caused no alarm, to get them to accept human beings in a motor vehicle or on elephant back, and it is thereafter possible to edge gradually in for photographs from close up. In this, for some reason, the much quieter sneeze of the Compur shutter seems less acceptable to most animals than the thud of the focal-plane shutter, but undoubtedly a loud thud upsets them, and has to be muffled. It is my experience that animals are much more sensitive to being photographed with an eye-level camera than with a camera held at chest level, where the ground-glass screen can be viewed without looking directly at the animal. Gaur, deer and most predators will not accept men on foot, and though there is a photograph of a gaur and a sambar in the photographic record of this survey, taken on foot, both were photographed not by getting them to accept me but by stealth. Most of the photographs documenting this report were taken from elephant back, a motor vehicle or boat or a tree-seat. Elephants and monkeys are best photographed on foot, though much care is needed in approaching the former in most parts of India. Almost all the elephant and monkey pictures were taken on foot.

The second and less obvious difficulty in wildlife photography in the forests of India is that even where the photographer is mobile, he cannot usually choose his stance or the subject's background, and has to take his pictures as he finds them, so that adequate tonal separation

between subject and surroundings and clarity of record (an essential) has to be achieved entirely by photographic technical shifts and not by posing the subject, or by waiting for it to reveal itself in a literally more favourable light—such forbearance usually results in his losing it altogether! This consideration is of much greater consequence than may be imagined, for in our forests the lighting is often extremely contrasting, with hardly any reflectance from the highlights into the shadows. For this reason, a thorough understanding of the colour rendering of the emulsion in use as also of the exploitation of the relationship between exposure and development is necessary for good candid pictures.

Considering how integral a part of this report its photographic record is, two further matters may be briefly set out. An original attempt was made to evaluate the comparative size of the same species (average specimens) in different areas, purely by photography. This failed because of accidental damage to the camera specially constructed for this purpose, but is sufficiently interesting to be retailed here.

In this camera, the rigid parallelism of the lens board to the film plane was ensured by the lens board moving along two tracks set at right angles to each other. The camera was equipped with a 240 mm. telephoto lens of hard definition, with a maximum aperture of $f\ 5.6$, and the traverse of this lens from infinity to 15 feet was accurately calibrated. Further, a rigid lock was provided so that the lens could be locked at any desired position on the footage scale. The lens was locked when it was focussed at 100 feet, and a rangefinder right beneath the viewfinder was also locked set at 100 feet. Depth of field tables are calculated on contact prints, so that when the negative is enlarged to 10 or 15 diameters, the depth is very shallow even at 100 feet for a lens of the focal length used at its maximum aperture of $f\ 5.6$, only about 8 feet. Preliminary experimental work showed that it was not too difficult to move back or forward a few feet, when one was about 100 feet from chital, gaur and other animals, so as to get the split images in the rangefinder to coincide exactly, though at this distance it was not possible to eliminate errors of a few feet. I hoped to use this camera, set up on a tripod if possible a measured distance of 100 feet from some animal path used by chital and other animals, and to photograph them (by remote control, if necessary, the camera being equipped with a solenoid which could be operated from 100 feet away) at 100 feet, broadside-on, in different areas. Errors in the estimation or measurement of the distance would be immediately shown up when the negative was scrutinised through a highpower magnifier, and it was proposed to mark all successful negatives with code numbers, to indicate the date and area of each picture, and then to evaluate comparative size in different areas by measuring the 15-diameter blow-ups from the successful negatives. Image size, in such a set-up, being directly proportional to subject size and nothing else, it should

have been possible to get reliable comparative data by this method. The main difficulty, in fact, would have been not in the photography so much as in the ensuring that the subject and camera were on a plane more or less (otherwise foreshortening and other perspective errors might have complicated matters). Owing to the footage-scale of this camera getting damaged beyond repair in a road accident, soon after it was built, it was not possible to lock the lens at 100 feet and hence the attempt was abandoned. However, since the traverse of the lens was unaffected up to 75 feet (the maximum distance at which pictures could be taken at night with the aid of 2 Metz 502 electronic flashes) it was used exclusively for night photography, and all the night pictures in the record were taken with it.

In many faunal areas (for example in Andhra Pradesh, Orissa and parts of Bihar) animals which are diurnal in less disturbed habitats have turned crepuscular and nocturnal: in fact, in these locations, only at night could any wild mammals be seen, and it was important to my survey that I should get clear pictures of them. The problem here was twofold. The spill of light from the wideangled flash-heads on to the bonnet and other parts of the jeep resulted frequently in reflection-flares that completely ruined the pictures: hoods to narrow the throw of light were devised for the flash-heads, and this also helped in the more even illumination of the field from about 30 feet away. The second problem was that driving along forest roads in an open jeep at night, it was seldom possible to see animals closer than 50 feet away, and inadvisable to open the aperture wider than $f\ 8$, as some depth of field was highly desirable—at night the rangefinder could not be used and setting the lens by guessing the distance, the lens had to be stopped down slightly to allow for small errors in the estimation of distances. The guide-number used by professional photographers for taking pictures of open-air processions at night were far too high in the jungle, even though they used the same film and the same electronic flash as I did. Using 2 synchronised flashes, and forced development, I found that printable negatives could be obtained when the subject was 50 feet away, with the lens aperture at $f\ 8$, but *not* at 60 feet. Finally and somewhat desperately a new technique of forced development was evolved which solved the problem. The film (Kodak Tri-X Pan) was developed in May & Baker Promicrol at a dilution of $1 : 2\frac{1}{2}$ and development continued till a slight base-fog built up. The time taken for such unobjectionable fogging was noted, and 4 times the tank capacity of the diluted developer was mixed. Then, fixing the time at a little less than the time fixed originally, the used developer was poured out and replaced by fresh developer thrice, at quarter the development time fixed. Successful negatives were obtained even with the subject 75 feet away by this technique.

SCOPE, BASES AND ARRANGEMENT OF THE REPORT

Being mainly based on a series of repeated sample surveys, in many of the best faunal areas in peninsular India, carried out over a 12-year period, this report has no pretensions to being a study of distribution or a taxonomical natural history of the mammals of the region: it is, in fact, a factually-based ecological mammalian evaluation dependent mainly on the study records specified already, and also on earlier experience and knowledge. All individual faunal assessments, as distinct from the reports of a team of workers, are substantially of this nature, but usually they contain the sum total of the faunal knowledge of the author up to the period of publication. In this report, however, the field records have been limited to a period of 12 years from 1959 for reasons already stated, and even within this period, the observation made during brief trips, unsupported by detailed, on-the-spot field notes, has been left out.

For instance, it will be noticed that the records relating to one of the commonest wild mammals of the region, the bonnet monkey, are quite meagre. I have watched and photographed this monkey in many places where it is the local faunal feature, such as Tirupathi, Courtallam, Pappavasam, Siddharkoil, Jalarpet, Kodaikanal Road, and in and around some suburban towns, but these observations have not been included in the field notes here for chronological reasons, or because there are no detailed notes supporting them, or because they were not made in forest areas. Similarly, no mention at all is made of the commonest diurnal wild mammal of peninsular India, the palm squirrel, for though many photographs and even observation notes of it are available, they are wholly unrelated to the forest areas in which the work on the survey was done.

The field notes¹ have been analysed and the sight-records (varying in duration from a mere glimpse to 3 hours of close watching, and in number from an individual to a herd) of each species mentioned in them separately collected and studied. Since this report is ecological and not on behaviour, the approximate total duration of all observation has not been specified for each species, but other details culled from these field notes have been briefly specified at the commencement of the chapter on each species. In these chapters, as well as in the chapter which provides the overall survey, references are made to photographs and field observations supporting statements and conclusions. For this purpose, the study locations have been prefixed with initials, following their arrangement in the field notes and photographs, as indicated below:

Kerala	..	..	..	..	K
Tamil Nadu	..	..	..	..	TN
Mysore	..	..	..	..	MY

¹ See footnote at p. 504.

Andhra Pradesh	..	..	..	..	AP
Orissa	..	..	..	..	O
Bihar	..	..	..	..	B
Madhya Pradesh	..	..	..	..	MP
Maharashtra	..	..	..	..	MR
Other miscellaneous areas	..	..	..	..	MISC

These initials, followed by the year, month and date of the observation, should be quite adequate for the immediate location of the passage in the field notes to which reference is made. Similarly, the code number of any photograph will suffice to locate it, by reference to the list of photographs provided.

EVIDENTIARY RECORDS OUTSIDE THE REPORT

Thousands of negatives from the field trips made during the 12-year period of this survey (roughly, 6000 negatives) have not been printed for this report for various reasons, though they were all scrutinised and many have been printed in the past for other purposes. The main reason for this, of course, was that some reasonable limit had to be set to the number of illustrations to any text. Many of these negatives are repetitive, being pictures of the same subject taken in sequence at one opportunity; many are of poor quality and are only proof of the subject having been seen in the circumstances set out; a great many have only pictorial and not evidentiary value. Nevertheless, these negatives have been sorted out and stored, so that in the unlikely event of any statement made in this report requiring additional proof, they may be available in case they contain the evidence needed.

During the first 10 years, some of the observation notes and photographs from field trips were used in faunal contributions to newspapers and magazines, and also in survey reports to governments, mainly for my 'Country Notebook' column in *The Statesman*. It is therefore possible to establish that these observation notes were anterior in point of time to those publications and reports.

NONPROVISION OF BIBLIOGRAPHY

The nonprovision of a bibliographic list of the faunal literature consulted or relied upon (as an appendix to this report) may be explained here. I am indebted to booklore for much of my knowledge of Indian wild animals, to some 50 books. These are of 3 main categories, shikar literature, the accounts of naturalists and conservationists, and faunas and specialist studies, compilations and reports.

Among the authors of shikar books I have read, the following may be mentioned, more or less in chronological order: W. Rice, M. H,

Shakespear, J. Forsyth, J. Baldwin, E. Braddon, J. Inglis, A. J. O. Pollock, D. Hamilton, G. P. Sanderson, E. F. Burton, R. Sterndale, C. E. M. Russell, A. Mervyn Smith, A. I. R. Glasfurd, the Maharajah of Cooch Behar, S. Eardley Wilmot, E. P. Stebbing and F. W. F. Fletcher (c. 1860 to 1912): Best, A. A. Dunbar Brander (his is really much more a valuable natural history than a shikar book), R. G. Burton, Hewett, C. H. Stockley, Musselwhite and Wardrop, between the two World Wars: and thereafter, J. Corbett, K. Anderson, A. Locke, A. Powell, Kesri Singh and H. Allen, most of them writing about tiger hunting.

Among the books of conservationists and naturalists should be mentioned *TWO YEARS IN THE JUNGLE* by W. T. Hornaday (who came to India in 1877), *WITH A CAMERA IN TIGER-LAND* and *THE JUNGLE IN SUNLIGHT AND SHADOW* by F. W. Champion (notable for their magnificent photographs), *THE WILD LIFE OF INDIA* by E. P. Gee (a sound over-all account with many fine photographs), *ELEPHANT GOLD* and *TIGERS* by P. D. Stracey, and *THE TWILIGHT OF INDIA'S WILD LIFE* by B. Seshadri.

The faunas and specialist studies and publications include *MAMMALS OF INDIA* by Jerdon, the 2 volumes on mammals in *THE FAUNA OF BRITISH INDIA* by W. T. Blanford, Sterndale's *MAMMALIA OF INDIA* revised by F. Finn, *THE BOOK OF INDIAN ANIMALS* by S. H. Prater (second edition, 1965), *THE DEER AND THE TIGER* by G. B. Schaller, and notes and articles in the *Journal of the Bombay Natural History Society* (the last two specially valuable). Naturally, other scientific faunal books not dealing specifically with Indian mammals were also read, but are not indicated here.

If this report was primarily concerned, as it is not, with the decline of the country's mammalian wildlife over the past 100 years, an accurate bibliography of all these and some other books would have to be provided. For example, in the Banjar Valley area of Madhya Pradesh, the faunal decline is graphically indicated by what Forsyth, Dunbar Brander and Schaller have written of the local fauna as they knew it in 1861-63, 1900-21, and 1963-65 respectively: Brander further records the decline within the 20-year period of his knowledge of the area. Where such comparative assessments by different observers, spread over different periods of a century, sustain the argument of the text of a report or analysis, the dates and other details of publication of the sources have value and should be furnished in an appendix. In the present report, limited in period and confined largely to a series of repeated visits to widely scattered faunal areas, an added bibliography would serve no useful purpose and can only be pretentious. Further, to be properly done it would entail an enormous amount of work and time—in no book on India's fauna published in the last 3 decades that I have seen is the bibliography complete or wholly free from error.

Wherever it is necessary to refer to the opinion or record of any authority either to corroborate some statement in this report, or because my observation or inference differs from that of others, specific citation of such agreement or difference will be made in the text.

POPULATION FIGURES : QUANTITATIVE FAUNAL ASSESSMENTS

In the areas worked, the populations of some free-ranging species, such as elephants and gaur, naturally displayed considerable fluctuations with the seasons; further, even at the same time of the year, there were noticeable fluctuations in their numbers in different years caused, apparently, by climatic or other seasonal variations like drought or unseasonal rainfall. Other species, like chital and muntjac, were widely distributed over many localities either in mobile populations (chital) or individually (muntjac), so that working singlehanded and for a limited period in each area, it was not possible to attempt even a rough count in all localities. Again, the predators were either so largely nocturnal, like tigers and leopards in most places, or so little given to residence in particular localities, like wild dogs, that it was exceedingly difficult to see them, leave alone count their numbers. In many areas where the normally diurnal animals had become furtive creatures of the night owing to sustained disturbance by humanity during the day, drives along forest roads were regularly undertaken, usually both an early drive at nightfall and another late at night, and sometimes predawn drives as well.

In places the sanctuary authorities had conducted a regular census, and where this had been done, close inquiry was made into the methods employed, and the official figures studied. All that is expected of a faunal census is an approximation to the truth, and even where the approximation is wide, if it is adequately representative and if the method employed is sound, a census, enumeration or rough count is better than an educated guess. But where the method is unsound and some of those entrusted with the counts are inept, the census figures obtained, while possessing the verisimilitude of all statistical figures comprehensibly displayed, might be widely misleading. Only in a few instances did the official figures seem substantially true.

Everywhere, but especially in areas where the animals were hard to see, all means other than actual sight records were exploited to determine the presence of wild animals—by exploring nullahs, the edges of pools and water-holes, and forest paths, and noticing and studying foot-prints (usually with the aid of skilled trackers), forms, fæces, the regurgitated stones of fruits by cud-chewing animals, evidence of feeding offered by the vegetation, and by listening carefully for animal sounds, especially early in the morning and late in the evening. Local inquiry was also

made of forest-side villagers and others, but with experience less and less reliance was placed on hearsay.

Summaries of sight records, counts and other observed details are provided at the start of the chapter on each species studied.

ECOLOGICAL SLANTS OF THE SURVEY

The circumstantial factors influencing the mammalian wildlife of the areas studied, such as terrain and vegetation (as providing cover and food), as well as the habits of the animals, intra- and extra-specific relationships and other details of their life, have been set out in this report based on specific observations as recorded in my field notes, and brief general accounts of certain sanctuaries have been provided in those notes (as already stated). The main features of this report are that it is documented with contemporaneous, on-the-spot photographs, and that both in the field notes and in the report an attempt has been made to study the human biotic factors, generally noticed in ecological reports mainly when they are acutely and overtly hostile (as when poaching or hunting is an appreciable factor), in their entirety, taking all relevant aspects (some insidious or covert) into consideration. The repercussions of forestry and other operations, large-scale projects in and around faunal areas, and of other human activities in and around sanctuaries (such as cattle grazing and the collection of forest produce) on the native uncultivated flora and fauna of the area have been studied and briefly reported. It may be repeated that this is mainly a contemporary report, and that while influences going back to a distant past have not been ignored, prevailing circumstances have been considered.

GENERAL ACCOUNT OF SOME OF THE STUDY AREAS

KERALA

Periyar Sanctuary

Relevant aspects of the history of the sanctuary: In any appraisal where human influences on the native wildlife are taken into consideration, certain aspects of the history of the Periyar Sanctuary become relevant and may be set out briefly. The Periyar River was dammed about 1897 mainly as an irrigation project; it was then considered a unique feat of engineering skill, and the project still remains an achievement of considerable magnitude: the object of the design (conceived and executed by Col. J. Pennycuick, R.E.) was to divert the waters of a montane river

(the Periyar) emptying itself into the western sea, through a long subterranean channel, into another river having its origins in these hills and flowing eastwards (the Vaigai), so that a vast tract of barren plains land could be irrigated. Subsequently, the project was also converted into a hydroelectric one, i.e., into an irrigation-cum-hydel project. It was never intended as a sanctuary, *ab initio*.

It was only some 30 years ago that the then Maharaja of Travancore, realizing the great scope of the area as a sanctuary and its magnificent beauty, constituted it as a sanctuary. The authorities who originally built the project, in the British days, took infinite pains to do nothing that would spoil the great natural beauty and floral and faunal wealth of the area. Nothing artificially obtrusive, no modern facilities and no exotic plants, were known in the area in those days. However, it should be noted that since the project was developed as an irrigation-cum-hydel project, as the result of co-operation between the Madras Government and the Maharaja's Government, certain vested human interests, whose influence on the fauna and flora was not even considered, came to establish themselves in the present sanctuary area, and all around it. Inside the sanctuary, the Madras Government has control over the many-armed lake created by the damming of the river (on a 999-year lease) and the Kerala Forest Department over the extensive forests around the lake. These two government authorities are not the only ones with vested interests in the area: several tribals, now organised into a few settlements, had interests here (mainly in its floral and faunal resources) and their interests were, and are, antagonistic to the wildlife. Further, there are some private holdings of land within the sanctuary, and any number of estates and plantations all round.

In recent years another human authority has developed interests inside the sanctuary, the Kerala Tourist Corporation, a public limited company which caters to the tourists, mainly to the foreign tourists. There are also other private agencies.

Location and extent: Periyar Sanctuary (Thekkady) is not far from the borders of Kerala and Tamil Nadu along the Madurai border of the latter. The extent of the sanctuary is 304 sq. miles and of the lake, its main attraction, variable from about 10 to 12 sq. miles. The maximum level of the lake is 2860 feet above MSL.

Terrain and environmental factors: The sanctuary is part of an even vaster mixed deciduous forest with a decided evergreen character in many places, and is hilly, varying in elevation from about 3000' to 6000'. Rain-fall varies but is generally heavy, and there are many creeks and swampy flats. The brief floristic account that follows will be indicative of the edaphic and climatic factors obtaining, and the historical note of its biotic (human) environmental factors. The peripheral forests of the sanctuary have been much depleted in recent years by their exploitation

for various purposes. During summer, the lake and its ramifications offer the main source of water to the animals.

Floristics: The most interesting floral feature of the sanctuary is not its actual composition so much as the ecological changes induced by the artificial formation of the reservoir and waterspread, by the pent-up waters banking against the hillslopes which, by their very steepness, could have had no source of water originally except during the rains. No study of these changes has been made but it is apparent that at least certain waterside plants such as *Ochlandra* spp. and some sedges, could not have been found in such profusion on the hillslopes and terraces abutting the water before the formation of the lake.

The introduction of exotics into the area has also considerably affected the floral ecology of the sanctuary in places. Near the dam, the hilltops have been extensively planted up with *Eucalyptus grandis*. Lantana has spread thickly in places, as near Aiyappankurukku. *Eupatorium glandulosum* has, recently, established itself in the area.

However, the integrity of the flora of the inner reaches has changed little in the past few decades. The sholas still retain their peculiar, semi-evergreen nature. Many of the trees found in them are either peculiar to Kerala or attain their best development hereabouts; examples are *Gluta travancorica*, *Dipterocarpus bourdillonii* (other Dipterocarps also occur here—*Hopea parviflora* and *H. wightiana*, & *Vateria indica* should be mentioned), *Xylia xylocarpa*, *Poeciloneuron* sp., *Dysoxylum malabaricum*, (*D. beddomei*, and *D. ficiforme* also). Besides these, other important trees of the area that should be mentioned are: *Artocarpus hirsuta*, *Stereospermum* sp., *Terminalia* spp., in particular a variety of *T. tomentosa* where the bark is not conspicuously fissured, *Adina cordifolia*, *Lagerstroemia lanceolata* and *L. speciosa*, *Messua ferrea*, teak, *Lophopetalum wightianum*, *Mangifera indica*, *Pterocarpus marsupium*, *Calophyllum tomentosum*, and *Tetrameles nudiflora*. Teak is common in the deciduous areas. Most of the tree-stumps that are now to be found in the lake, sound in their wood though deeply pitted by time and the elements, belong to the hardwoods in the list above.

In the shola and other tree forests, the undershrub is often fairly open and seldom thorny. The hilltops are of the peculiar nature, clad mainly with herbaceous plants, termed 'downs' in the Nilgiris. While many grasses, both short and tall, are the dominant components of these downs forests, there are a great many other herbaceous plants besides them, including plants of the order Cyperaceae. The main grasses are: *Apluda mutica*, *Arundinella holcoides*, *Cymbopogon citratus*, *Eragrostis gangetica*, *Hackelochloa granularis*, *Paspalum scrobiculatum*, *Panicum repens* and *P. montanum*, *Themeda cymbaria* and *T. triandra*.

TAMIL NADU

Point Calimere Sanctuary

Location, extent and general character: Point Calimere is on the eastern coastline of the Thanjavur District, where the coast projects in a sharp nose into the sea, so that the sea runs more or less north and south of its pointed tip. The sanctuary consists of the coastal reserved forest, of about $7\frac{1}{4}$ sq. miles of the 'Kodiakadu Reserved Forest' as per the Government Notification constituting the sanctuary in June 1967.

The English name 'Kodiakadu R.F.' used in official records appears to be a distortion going back to the British days: the Tamil name is 'Kodi-k-kaadu', 'the farthest forest', and in this note the name will be spelled 'Kodikadu'.

The main faunal feature of Point Calimere is its great assemblies of flamingos and other water-birds in the swampy lagoon. This lagoon, called the Great Swamp, is very shallow and miry, and can be traversed by a Masula boat along certain routes. There are a few islands in the lagoon, one at least large enough for the semi-feral ponies to be grazed in. Misled by a report about mammalian predators preying on the water-birds, much time and effort was wasted in trying to trace them, but it now seems clear that the report was without basis.

Apart from its bird life, Point Calimere Sa. (the Kodikadu area) is notable for two main reasons. Agriculture here has been so much frustrated by the animals (pig, horses, cattle and perhaps chital) raiding the crops, that only tobacco, which the animals do not touch, has been raised here. The second point of interest is that most of the mammalian species inhabiting the sanctuary appear to have been introduced. The ponies and cattle are definitely introduced, though some of the cattle have now run wild and are, unlike the ponies, beyond recapture. The chital have been introduced and the pig seem feral. The bonnet monkeys are known to have been brought into the area in April 1965. The truly indigenous mammals of the area (among the larger animals) appear to be the black-buck, the jackals, and the mongooses on land and the dolphin in the sea around.

There are no large predators. Leopards do not occur in the area. Jackals and mongooses seem to represent the only predators on the land.

The area is sandy along the coast, and in the forest away from the beach, undulating, densely clad with bushes and stunted trees, but with many paths through the forest, and much frequented by humanity grazing cattle: there is a colony of aborigines inside the forest. The commonest animals here are the cattle let loose in the jungle to graze, to fend for themselves; cattle which have become dry or are otherwise unprofitable to their owners are let loose in the forests, and recaptured as needed.

The 'feral ponies' too, are owned and branded (as foals) but appear to be semi-feral, as they are no longer in demand as they were formerly.

Official statistics give the total numbers of blackbuck and chital in the area in several hundreds.

During December, when I visited the sanctuary, there were ample reserves of freshwater to the animals in ponds, ditches and hollows. Being coastal, the forests are exposed to storms and heavy rains. In summer, I understand the water available to the animals is limited to a few ponds inside the forest.

Floristics: The vegetation along the coast is very similar to the vegetation of other sandy beaches on the south-eastern coastline, consisting mainly of the following:

Spinifex squarrosus close to the sea on sand dunes: a few grasses (among which are *Cynodon dactylon*, *Chloris barbata* and *Eriochloa procera*) on the beach away from the sea; here and there, close to the sea, patches of *Salicornia brachiata* and *Suaeda monoica*; *Cyperus rotundus* on the beach and sandy flats. Herbaceous vegetation of sandy flats: *Launea* sp., *Lippia* sp., *Oldenlandia umbellata*; *Evolvulus alsinoides*, *Ipomoea pes-caprae*; *Prosopis juliflora*, introduced into the area some 20 years ago, has now spread into the forest away from the shore. A casuarina and an eucalyptus plantation have claimed part of the natural forest. Other exotics in the area are *Vinca rosea*, *Croton sparsiflorus* and *Tribulus terrestris*: in other words, the influence of exotics here is still negligible.

Hedges and brakes of pandanus have been planted, and other species introduced into the area are *Albizia lebbek* and *A. amara*.

The forest features these tree species: *Mimusops hexandra*, *Meme-cylon edule*, *Zizyphus mauritiana* & *Z. oenoplia*, *Pongamia glabra*, *Dichrostachys cinerea*, *Atalantia monophylla*, *Calophyllum inophyllum* (planted probably, in a few places near the sea); *Acacia arabica*, *Canthium didymum*, near the lagoon *Excoecaria agallocha* and *Avicenna officinalis*. *Morinda tinctoria*, *Randia dumetorum* rare. *Thespesia populnea* and *Pithecolobium dulce* (rare).

There are many shrubs, chief among them the following: *Clerodendrum inerme*, *Cassia auriculata*, *Carissa* spp., *Toddalia aculeata*, *Caparis sepiaria*, *Acacia intsia*. *Leucas* sp. in patches inside the forest. The flora is similar to that of the coast of Tamil Nadu.

Mudumalai Sanctuary

Location, extent and general character: Occupying a vast undulating hillside on the north-eastern slopes of the Nilgiris, in south-east Wynaad, the Mudumalai Sanctuary is one of the few areas in the country

specially blessed by nature with a rich and varied terrain, flora and fauna, and has long been celebrated among hunters (*vide* SPORT IN THE NILGIRIS AND ON THE WYNAAD by F. W. F. Fletcher—1911). It has had a chequered political history, having been held by Kerala and Mysore in the past. For reasons stated in the General Account of the Bandipur Sanctuary, the area of the Mudumalai Sa. (about 125 sq. miles or 320 sq. km.) cannot be considered faunally or florally or territorially distinct from Bandipur, or from the peripheral forested areas of Kerala, Mysore, or of Tamil Nadu itself. The entire area of about 250 sq. miles is one vast and varied stamping ground to the animals and one continuous vegetative tract, in spite of its great variations and political demarcation into the territories of Kerala, Tamil Nadu and Mysore and into the 2 main sanctuaries of the last two States. However, the two sanctuaries hold the major populations of the large wild mammals of the area.

In saying this, it must be remembered that these animal populations are not fixed or entirely resident. Apart from the animals moving around within the 2 sanctuaries to suit seasonal fluctuations and needs, the gaur and the elephants wander over forests outside the 2 sanctuaries as well. The deer are more restricted in their movements and may be considered resident, broadly speaking. The langur and bonnet monkey populations are also probably local, the leopards seem localised, but the tigers and wild dogs probably cover much ground.

Terrain and environmental factors: As said, the sanctuary displays considerable variations of terrain and flora. These differences are not based on differences in elevation so much as on topographical variations, the sanctuary being comprised of hills, hillocks, valleys, ravines, flats, swampy hollows in places, and much cut up by watercourses (rivers, streams and nullahs). The highest elevation is represented by Markundarai Betta, the top of which is 4154' high; for the rest, the high elevations are all around 3500' - 3600': the lowest elevation, at Masinagudi, is around 2900'.

The Benne and Doddakatti Blocks, towards the Kerala border, have a more evergreen complexion than the rest of the sanctuary: the Mudumalai Block consists of rounded hills with hollows in between, the hollows often being swampy, the kind of terrain designated by the local word 'gadde'. Kargudi is more deciduous, but still close tree forest, and moreover the clearings are choked up with tall grass: Theppakkadu, which features natural teak, is more open, with a floor where the undershrub is generally low. Masinagudi is ravine-cut and flat thorn bush forest, with the canals of the Moyar Project supplying perennial water. The entire sanctuary area is well-watered, with the Moyar and subsidiary streams running through. The average rainfall is around 56 inches.

All over the sanctuary, forestry operations are carried on. Selection felling and clear-felling are limited to one coupe per year, but the log-

ging, transport and sale of timber involves considerable forest area. Further, departmental collections of bamboo, and plantation work, are carried on over many areas. Furthermore, minor forest produce collections of many kinds are made on a wide scale both by departmental and extra-departmental agencies, and include the collection of honey, beeswax, myrobalans, bark-lichen, soapnut, tamarind and deer antlers.

The Moyar Project and its working, the activities of the populations living in the many settlements within the sanctuary, or close by it, (such as at Masinagudi, Theppakkadu and Lower Kargudi), and the claims of 14 private holdings within the sanctuary area, add further to the constant disturbance by humanity that the wildlife face here.

The main motor road from Mysore to Ootacamund, runs through the Mudumalai Sanctuary and cattle destined for the slaughter-houses are herded weekly along this road, in hundreds. These are usually decrepit and sick cattle from which infections might well spread to the wild ungulates. Besides this, great numbers of cattle are grazed in many areas in the sanctuary.

Floristics: The floristic variety of the sanctuary is one of its most important features. However, this variety lies not so much in the differences between plant species peculiar to particular areas or Blocks as in the varying stature and dominance that the same species attain in different areas. *Anogeissus latifolia*, found all over the sanctuary, exemplifies the point. In the Benne and Mudumalai Blocks it attains its best growth and is less gregarious than it is in Kargudi and Theppakkadu, and in Masinagudi it is insignificant both in stature and dominance. Again, while *Randia dumetorum* is widespread in the drier areas, it is *R. uliginosa* that is found in moist localities, often along with *Careya arborea*. Along nullahs and streams, brakes of pandanus and *Ardisia solanacea* occur, and along rivers and major watercourses mango, *Syzigium* spp. and other evergreens, and figs. *Phoenix humilis* is common in swampy flats and in clearings, and belts of tall grasses and of bamboo are dominant in certain localities. The bamboo of the sanctuary is *Bambusa arundinacea*.

Among the main tree species of the sanctuary, the following may be mentioned: those typical of particular localities are mentioned under those areas:

Adina cordifolia; *Albizia procera* & *A. odoratissima*; *Anogeissus latifolia*; *Bauhinia racemosa*; *Bischofia javanica*; *Bombax ceiba*; *Bridelia retusa*; *Buchanania latifolia*; *Canthium parviflorum*; *Careya arborea* in moist localities; *Cassia fistula*; *Cedrela toona* in the elevations; *Dalbergia latifolia*; *Diospyros melanoxydon* & *D. montana*; *Elaeodendron glaucum*; *Emblia* spp. (in the recent revision of the genus, some 4 or 5 species have been assigned to the area, and no taxonomic determination of these by a competent worker has been done so far); *Erythrina indica*; *Ficus*

bengalensis & *F. mysorensis*; *Gardenia* spp.; *Garuga pinnata*; *Gmelina arborea*; *Grewia tiliaefolia*; *Kydia calycina*; *Lagerstroemia lanceolata* & *L. parviflora*; *Machilus macrantha*; *Madhuca latifolia*; *Mangifera indica*; *Mitragyna parviflora* along streams; *Ougeinia dalbergioides*; *Premna tomentosa*; *Pterocarpus marsupium*; *Pterospermum rubiginosum*; *Radermachera xylocarpa*; *Randia dumetorum* & *R. uliginosa*; *Santalum album* (Kargudi, Theppakkadu mainly); *Schleichera oleosa*; *Schrebera swietenoides* (distinctive of the Wynaad); *Semecarpus anacardium*; *Shorea talura*; *Stereospermum tetragonum*; *Syzigium* spp.; *Tectona grandis*; *Terminalia bellerica*, *T. tomentosa* & *T. chebula*; *Trewia nudiflora* in moist localities; *Vitex altissima*; *Zizyphus mauritiana*; *Z. oenoplia*, *Z. trinervia* & *Z. xylopyrus*.

Pandanus sp. and *Phoenix humilis* occur in moist localities and in open flats (usually swampy) respectively. *Dioscorea* spp. and other corms occur all over the sanctuary. Among the twiners may be mentioned *Smilax aspera*.

Among the shrubs of the forest floor should be mentioned: *Abutilon indicum*; *Ardisia solanacea*; *Butea parviflora* (more often found as a flat-spread patch on the forest floor than ascending the trees); *Desmodium* sp.; *Flemingia bracteata*, *F. grahamiana* & *F. wallichii*; *Grewia hirsuta* and *G. aspera*; *Helicteres isora*; *Hibiscus lampas*; *Indigofera* sp.; *Limonia alata*; *Pavetta indica*; *Triumfetta pilosa*; *Toddalia aculeata*.

A variety of tall grasses and a few short grasses, and a great many herbs constitute a most valuable source of fodder to the animals. I was unable to get the grasses identified precisely.

A number of epiphytic orchids are found in the Kargudi-Mudumalai area. Mushrooms, puffballs and ledge-fungi of many kinds are found all over the sanctuary, many of them edible.

In the Benne and Mudumalai Blocks the trees attain their best development, and there is a greater admixture of evergreen species in these blocks, though in the north-eastern reaches of Mudumalai the trees are stunted, featuring small-sized *Anogeissus latifolia*, *Shorea talura*, *Soyimida febrifuga* and *Terminalia chebula*. Elsewhere in the Mudumalai Block, where the tree forests are tall, *Mussaenda tomentosa* is sometimes prominent in the undershrub.

While the giant bamboo (*Bambusa arundinacea*) is widely distributed in the sanctuary, it occurs in large gregarious belts in Benne, and a notable feature of these bamboo belts is that they seeded gregariously in the March of 1959, '63 & '64. *Elaeocarpus serratus* (and other species of the genus), *Sterculia villosa* and *Aporosa lindleyana* are among the trees of Benne, and *Colebrookea oppositifolia* occurs in its undershrub.

The Kargudi Block features many extensive belts of tall grass, rank and choking up the forests in September-October. *Solanum* species are a feature of its undershrub in places (as in C.2) and it is here and in

its reaches towards Theppakkadu (as also certain areas in Masinagudi, like the Avarahalla) that lantana flourishes most luxuriously.

The Theppakkadu Block is distinctive in its flora. Natural teak forests, with gregarious patches of *Anogeissus latifolia* in a few places, are the feature of its tree growth. The forest floor is open, and the shrubs, herbs and grasses that clothe it of low stature in the main (except in a few places where lantana has found a footing). A species of the ground orchid, *Habenaria* is found on the forest floor here: other features of the undershrub are procumbent *Butea parviflora*, *Flemingia* spp., and *Desmodium pulchellum*, and, in moist, flat locations a carpet of 'koovai' (*Costus speciosus*, and perhaps also another plant of the Zingiberaceae)—such patches of 'koovai' also occur in places in Kargudi. Apart from teak and *Anogeissus*, no other tree species occurs here gregariously, but among the species typical of the area are *Schrebera swietenoides* and *Eriolaena quinquelocularis* (in fruit in September). Both in Theppakkadu and in Masinagudi, *Argyrea fulgens* is a feature of the undershrub (and in Masinagudi, of open spaces) with its dark purple flowers.

Masinagudi is even more distinctive floristically, featuring a great many spiky shrubs and thorny trees and climbers. *Acacia intsia*, *A. concinna*, *A. ferruginea* and *A. catechu*, all the thorny species of *Zizyphus*, *Capparis* spp., *Gymnosporia montana*, *Toddalia aculeata*, and *Canthium* spp. are features of its flora, as also *Givotia rottleriformis*, and an erect tree-like *Euphorbia*.

MYSORE

Bandipur Sanctuary

Location and extent: The Bandipur Sanctuary (23 sq. miles or 60 sq. kms.) of the Gundlupet Taluk of Mysore is the heart of the Venugopal National Park of the old princely State of Mysore and is contiguous with the Mudumalai Sa. of Tamil Nadu along a wide border, along the Kakkanhalla and the Moyar. It lies to the east of the Doddakatti Block of the Mudumalai Sa., to the north-east of its Mudumalai Block and to the north of its Theppakkadu Block. The Moyar and the Kakkanhalla are fordable at many places along the Bandipur-Theppakkadu border, so that the animals commute freely between the two sanctuaries.

Terrain and environmental factors: Bandipur is not much lower in elevation than most places in the Mudumalai Sa.: these figures from the Survey of India topo-sheet No. 58A/10 (one inch to the mile) will prove this statement: Bandipur Sa.: Lodges—3265'; Mulapura Betta: 3768'; Mudumalai Sa.: Upper Kargudi—3270'; Lower Kargudi—about 2900'; Mudumalai—3285', Theppakkadu—3050'. However, Bandipur gives

the casual visitor the impression of a lower elevation because it is comparatively much less undulating in its topography, and flatter, and its forests are more open and the undershrub less dense and high. It should be appreciated that Masinagudi and its surroundings, set against the backdrop of the Nilgiris, is actually on a lower elevation than Bandipur, and that the Moyar reserved forests extend on both sides of the river into Mysore and into Tamil Nadu. There is not much difference in rainfall (average about 56" for the Mudumalai Sa.) but apparently edaphic factors differ, and the more uneven ground of the Mudumalai Sa., cut up by many watercourses, is more conducive to tree growth, the same species rarely attaining in Bandipur the stature they do in the Tamil Nadu sanctuary.

A notable feature of Bandipur is its many clearings holding short grass, which, except in summer, have a lawn-like greenness. Bandipur is much less spiky in its underbrush than certain areas of the Mudumalai Sa. (the Masinagudi area in particular) and holds much less tall grass: being only about 1/6 the size of the Tamil Nadu Sanctuary, it is a closer-knit area and more homogenous in character. Moreover, a notable feature of the area is the number of forest pools and tanks, natural and artificial, that it has, such as Tavarakatté, Kollakumalikatté, Kari Gowdana Katté, Aralikatté, Baisnapur Keré and Moolapura Keré. These provide the wild animals (and also the cattle) with water, and attract elephants and gaur when they hold water.

In spite of these differences, both from the point of view of the faunist and of the fauna, the Bandipur Sa. can only be considered a continuation of the Mudumalai Sa. (or the other way around) and territorially and floristically it is closest to the Theppakkadu Block of the Tamil Nadu Sanctuary, though lacking the flow of the Moyar right through it as at Theppakkadu. It also has points of resemblance to Masinagudi in its fauna and flora. A further point of resemblance between Bandipur on the one hand, and Masinagudi and Theppakkadu on the other, which is of importance to any ecological faunal study, is that in both there are abandoned forts, human settlements, and shrines, where the forest has reclaimed human settlements. In Bandipur, the presence of tamarind and banyan trees often marks these locations.

Perhaps the most notable feature of the Bandipur Sa. is that it is almost unique in India in that no forestry operations are permitted in it. To appreciate how vastly this has contributed to the faunal wealth of the sanctuary it is necessary to point out that in spite of privileged shikar being allowed in and around Bandipur, in spite of the extensive grazing of cattle in the sanctuary and the free exercise of village rights, the same animals (chital in particular) are much less shy of humanity in Bandipur than in the Mudumalai Sa.

Floristics: As mentioned, the tree species here do not attain a notable

stature and the canopy is generally not too high. The forest floor is fairly open, and the clearings are covered with short grasses : there are also clearings holding tall grasses and hillside flats and slopes covered with herbaceous pasture. The comparatively open nature of the tree forests and the undershrub, are factors that are of great faunal importance.

The main tree species include the following : *Acacia intsia*, *A. concinna* and *A. ferruginea* (not dominant—nowhere near as common as in Masinagudi in the Mudumalai Sa.); *Albizia lebbek*; *Anogeissus latifolia*; *Bauhinia latifolia*; *Buchanania latifolia*; *Butea monosperma*; *Canthium parviflorum*; *Careya arborea* in moist areas; *Cassia fistula*; *Dalbergia latifolia*; *Diospyros montana*; *Elaeodendron glaucum*; *Emblica* spp.; *Ficus bengalensis* and *F. mysorensis*; *Gardenia* spp.; *Garuga pinnata*; *Givotia rottleriformis* (less common than in Masinagudi); *Grewia tiliaefolia*; *Holarrhena antidysenterica*; *Kydia calycina*; *Lagerstroemia parviflora* and less commonly *L. lanceolata*; *Machilus macrantha*; *Morinda* spp.; *Ougeinia dalbergioides*; *Premna tomentosa*; *Randia dumetorum*; *Shorea talura*; *Syzygium* spp.; *Terminalia bellerica* and *T. tomentosa*; *Vitex altissima*; *Zizyphus xylopyrus*, *Z. trinervia* and *Z. mauritiana*. Tamarind, mango and wood-apple in places.

The main bamboo of the area is *Bambusa arundinacea* but *Dendrocalamus strictus* is also found. In places *Phoenix acaulis*.

The main shrubs are : *Anona squamosa*, *Flemingea* sp., *Gymnosporia montana*; *Grewia hirsuta* and *Grewia aspera*; *Helicteres isora*; *Indigofera* spp.; lantana in places; *Limonia alata*; *Pavetta indica*; *Solanum* spp.; *Toddalia aculeata*.

The herbaceous vegetation is rich, particularly in September-October. No identification of the grasses was possible.

ANDHRA PRADESH

Kawal Sanctuary

Terrain and floristics :

The forests around Birsaipet and the surrounding areas are said to be the best in the sanctuary. The ground is undulating, rocky in places, and with a few pools holding water in November. In most areas teak predominates, constituting about 60% of the tree forests; the other main species noticed were *Chloroxylon swietenia*, *Terminalia tomentosa*, *T. bellerica*, *T. chebula* and *T. arjuna* (the last near water), *Acacia sundra* (*catechu*), *A. leucophloea* and *A. arabica*, *Albizia lebbek* and another *Albizia*, probably *procera*, *Butea monosperma*, *Cochlospermum religiosum* and *Sterculia urens*, both in yellow, falling leaf and both with remarkably straight boles, *Careya arborea* here and there, *Zizyphus*

xylopyrus, *Z. oenoplia* & *Z. mauritiana*, *Lanea grandis* (uncommon), *Boswellia serrata*, *Madhuca latifolia*, *Pterocarpus marsupium* (in flower), *Bauhinia racemosa*, *Dalbergia paniculata*, and *Emblica* spp. (*E. officinalis* & perhaps another species).

In many areas the 'male bamboo', *Dendrocalamus strictus*, grew gregariously or in clumps amidst the trees, and was in a very leafy and lush phase—the culms here are hollow.

In some places teak was sparse or absent, and in such places *Chloroxylon swietenia* and *Boswellia serrata* were prominent; in places *Cleistanthus collinus* grew gregariously and dominated the vegetation.

The undershrub was very thick and luxuriant, and consisted mainly of regenerating teak and gregarious regenerating *T. tomentosa* and other trees—evidently the forests were clearfelled some years ago. *Butea superba* was also prominent in the undershrub. Inside the tree forests there was little grass, though in clearings there was grass, and there were areas where thatching grass grew in abundance.

The forests were dense rather than open, the undershrub in particular being thick. There were paths in a network, overgrown with vegetation in most places in November. I learnt that in summer the forests are much more open and 'negotiable'.

Pakhal Sanctuary

Pakhal Sanctuary features a beautiful lake, which has its own wildlife (mainly birds, and crocodiles in one of its reaches). The forest is fairly thick, of a mixed deciduous nature, and holds trees of faunal importance such as *Emblica* spp., *Gmelina arborea*, *Careya arborea*, *Bridelia retusa*, *Terminalia bellerica*, and mohwa. The undershrub is notable for its comparative scarcity of herbs and grasses and holds many shrubs of faunal importance such as *Helicteres isora*, and *Grewia* spp. Eturnagaram has a richer tree growth and features belts and patches of grasses; the forest floor here is generally less shrubby and more herbaceous.

Both sanctuaries are in the process of being rehabilitated after being much depleted by years of intensive hunting and poaching—indeed, this is true of all sanctuaries in Andhra Pradesh, and while this is true to some extent of all Indian sanctuaries, I feel that the wildlife of Andhra Pradesh is best assessed or investigated after a fair period of the restorative effort. From the point of view of floristic ecology, the floral environment is still quite favourable to mammalian wildlife; however, the biotic (human) environmental factors may change very considerably, after a comparatively recent period of acute hostility.

BIHAR

Hazaribagh National Park*History of the recent past.*

Hazaribagh today is one of the best-forested districts in Bihar, some 45% of the total area being forested. Nevertheless, its floral history is one of sustained devastation.

Haines, in his *BOTANY OF BIHAR AND ORISSA* (1925) cites the District Gazetteer of 1917 which contains a note on the flora of Hazaribagh (and Monghyr) by the Rev. S. L. Thompson, formerly Principal of St. Columba's College, Hazaribagh. The following passage from that note of 1917 is significant: 'Unfortunately no report on the Hazaribagh flora can omit the most striking fact about it, i.e., its rapid disappearance. The forest is being most wastefully destroyed, and with it a great number of plants of great botanical and economical value are becoming extinct . . . where even ten years ago there was considerable jungle.' (p. 70, Introduction, *BOTANY OF BIHAR AND ORISSA* by H. H. Haires).

Subsequent to 1917 the devastation continued, though certain areas in the present National Park, then the game preserves of the Raja of Ramgarh, were strictly protected and preserved intact. When this zamin forest was taken over about 1948, except for these protected game reserves of the Raja, the rest of the forest was heavily burdened with human rights (right to collect fuel, small timber and mohwa flowers, and to graze cattle), and there were quite a few villages inside the sanctuary area. Those villages are still there, and no doubt they are no singular exception to the stupendous population increase that has overtaken the country during the past 20 years. Considerable tracts of the forest have been ceded to agriculturists following the taking over of the ex-zamin forests, on a Government decision to cede to agriculture all land bearing traces of the plough. Today, even in those areas which were strictly protected prior to 1947, cattle are grazed and fuel collected. Although fuel collection is intended to be limited to dead wood, in actual fact live trees are also cut for fuel, on the sly.

The fauna had also been greatly depleted when the forest was taken over by the Government, and inquiry of many people who knew the forest then reveals that few animals could be seen, even at night.

Terrain and general factors: The extent of the National Park is about 75 sq. m.

Hazaribagh consists of an undulating plateau, of broad, mound-like elevations with broad, shallow depressions in between, cut up by nullahs, and clad in sal and a deciduous tree forest, with an undershrub rich in herbs. The soil is porous, sandy along the nullah, and except in depressed, shallow basins of clay neither the topsoil nor the subsoil is

capable of retaining water. Because of this rapid drainage, and not because of poor rainfall, water is a major problem for man and beast during summer.

The climate is cool and dry, and I am told that during the cold weather Hazaribagh is now the coldest place in Bihar, though formerly Ranchi was. Arriving here very early in February when the days were brilliantly sunny, I noticed that even the natives wore shawls and blankets during the day.

A National Highway runs through the National Park, and only the area to one side of it (from Pokharia gate to Rajderwa) has been properly developed as a National Park, though 2 watch-towers have been built on the other side, too.

The most notable biological factor of the area is that during the day there are people all over the forest, collecting firewood, grazing cattle and passing through; man is much the commonest diurnal animal of Hazaribagh, the wild animals being nocturnal and crepuscular, mainly in consequence of this disturbance by men.

Although territorially distinct, it should be realized that the Hazaribagh forest (National Park forest) is only a part of the forest complex around it, and that the forest is very similar in composition and complexion in outlying areas, like Kodarma and Gomia. The animals no doubt commute between the protected and unprotected areas, but tend to concentrate in the former, the incentive for this being mainly the protection they gain here.

Flora

Hazaribagh is mainly a sal forest, but not a sal forest where *Shorea robusta* dominates all else, as in the Simlipal hills of Orissa; the sal at Hazaribagh, cut down in the past, is now in a regenerating phase, and is associated with a number of deciduous species, which grow along with and independently of it, in patches. Besides sal, which occurs in patches rather than in continuous belts, these are the main tree species.

Acacia catechu: *Khair*. Commoner away from sal, along the nullahs especially, than in the sal patches. Common in clearings; *Adina cordifolia*: Not common. Formerly commoner, as evidenced by old floras; *Aegle marmelos*: more young trees seen than old ones. A tree of great faunal importance; *Ailanthus excelsa*: formerly very common, as evidenced by old floras. I saw very few; *Anogeissus latifolia*: here and there in the interior. Saw no gregarious patches of it, as I have seen elsewhere; seems to have been commoner formerly; *Bauhinia* sp.: Bauhinias are quite a feature of the forest. Among tree species, there seem to be several, none in flower when I saw them. *B. racemosa* and *B. purpurea*, and one or two others occur here. The liana, *Bauhinia vahlii* is very common here; in fact, I cannot recall any other forest area

in India where it is so common. I noticed that here, too, it is only rarely or occasionally that it attains to the status of a tree-strangling liana, and that usually it is a harmless, straggling, scandent, low bush, providing lush foliage that is easily accessible; *Bombax ceiba*: The red silk-cotton. In flower in February-March, and therefore conspicuous. Along the nullahs. Attracts a great many birds; *Boswellia serrata*: *Salai*. Much the commonest tree here, after sal. Forms gregarious stands covering the hilltops, and also grows along with sal and other trees. In flower in March. Deciduous and bare in February; *Bridelia retusa*: Seen occasionally, but probably common in places. Wood seems to be valued as fuel. Saw several branches, with the leaves still on them, being carried by fuel-collecting women on their heads; *Buchanania latifolia*: Very common. In flower in February-March; *Butea monosperma*: Palas. The flame of the forest. Not in flower in February. Less common than in other similar forests in Bihar. The liana, *Butea superba*, also occurs, usually as a flat-spread bush; *Cassia fistula*: Not common. I looked for it in the cleared patches where it is often dominant and could not find it commonly there; *Diospyros melanoxylon*: Sporadic. Said to be common in certain areas. A tree of considerable faunal importance; *Emblica* sp.: Most probably *E. officinale*: Not uncommon. A tree of considerable faunal importance and definitely not a 'sal associate'; *Gardenia* spp.: None in flower, when I saw them; *Garuga pinnata*: A tree of considerable faunal importance. Sporadic; *Lagerstroemia parviflora*: Very common. I noticed that all the trees I saw were young ones, and that none had attained to a stature of over 30 feet; *Madhuca latifolia*: The Mohwa. Common. Beginning to flower in February and in profuse flower in March. The animals do not get a chance to eat the flowers as people camp all night under the tree, with fires lighted, to collect the fallen flowers at dawn. An important item of food to the people here. No reason why they should not, as in the South, plant mohwa groves around villages for human requirements. No such plantations in Bihar; *Mallotus philippensis*: Very common, especially away from sal along nullahs—also with sal. In fruit in February; *Nyctanthes arbor-tristis*: Fairly common. Drying up in February; *Pterocarpus marsupium*: This valuable tree was formerly much less uncommon. Only a few small trees seen; *Terminalia tomentosa*: Fairly common. Young, bush-sized saplings in clearings. *T. bellerica* (a tree of considerable faunal importance) is uncommon: *T. chebula* (the myrobalan) less so; *Semecarpus anacardium*. The bamboo of the area is *Dendrocalamus strictus*, which grows in clumps all over. An important plant, faunally.

Shrubs and herbs: The undershrub and clearings are rich in many plants. I did not try to work out the common spp. for I do not have the botanical knowledge, particularly of the grasses needed. A competent

field botanist, with a good herbarium and good floras to aid him, should find Hazaribagh very rewarding.

There are many grasses in clearings, in the undershrub, and along nullahs, short or of medium size, still green in February.

Phoenix acaulis (*Phoenix humilis* ?) is common in clearings and along the nullahs : it seems to be *acaulis*, having no stem, or bole, of any height. This is a plant of faunal importance, both the fruit and the young leaves being eaten.

Among the shrubs may be mentioned *Cassia tora*, *Carissa* spp., *Flemingea chappar* and probably another species or two, *Indigofera* sp., and *Holarrhena antidysenterica*.

BETLA

Palamau National Park

The Palamau National Park of Bihar is in the western part of the Chotanagpur district of Bihar, and is now about 96 sq. miles in extent. However, since I did most of my work in the Betla area of this park, best developed as a sanctuary and only about 12 sq. miles in extent, this note is confined to that area.

Betla consists of dry deciduous forests (plains forests at the foot of low hills) and is very dry in summer (when I was there), though it is almost enclosed between two rivers, the Koel and the Auranga, in which there is always some water. The animals do not move out of the dry area to the riversides or to the better-watered forests around during summer, when both the drought and the heat are severe—some of them, the elephants for example, do, but even the tiger and the chital and the gaur stay on here, finding such water as they can in drying water-holes, puddles and the few artificially improved hollows. Rainfall averages about 45 inches.

Permanent hides (watch-towers, one, Madhuchuan, a ground-hide) have been built near these sources of water, and observation of the animals, and to a lesser extent photography, is possible from them.

Terrain and floristics : Betla is almost flat, though the hills are close by. The main tree species are *Acacia catechu*, *Adina cordifolia* (in the moister areas), *Aegle marmelos* (quite common), *Anogeissus latifolia* (stunted), *Albizzia lebbek*, *Alangium salvifolium*, *Bauhinia retusa*, *Butea monosperma*, *Buchanania latifolia*, *Boswellia serrata*, *Cochlospermum religiosum*, *Cleistanthus collinus*, *Cassia fistula*, *Chloroxylon swietenia*, *Cordia myxa*, *Diospyros melanoxylon* and *D. montana*, *Emblica* spp., figs., *Garuga pinnata*, *Hymenodictyon excelsum* (in places), *Holarrhena antidysenterica*, *Lagerstroemia parviflora* (stunted), *Madhuca latifolia* (common), *Morinda tinctoria*, *Nyctanthes arbor-tristis*, *Lannea grandis*,

Pterocarpus marsupium (stunted), *Semecarpus anacardium*, *Syzgium cumini*, *Schleichera oleosa*, *Soymida febrifuga*, *Sterculia urens*, *Terminalia* spp., *Wrightia tomentosa*, *Zizyphus mauritiana*, *Z. xylopyrus* and *Z. oenoplia* figs., and the red silk-cotton, near water.

The forest floor is fairly open, and covered with grass in places. Among the grasses of the area are *Apluda aristata*, *Cryspogon* spp., *Heteropogon contortus*, *Imperata arundinacea* and *Saccharum spontaneum*.

Betla is noted for its bamboo : the bamboo of the area is *Dendrocalamus strictus*.

The grazing of cattle and the collection of thatching grass and fire-wood is allowed or otherwise indulged in. There are villages around.

THE REPORT OF AN ECOLOGICAL MAMMALIAN, SURVEY OF PENINSULAR INDIA : 1959-70

The factual bases of this report have been fully set out in the field notes, the introduction, and the discussions of each of the 33 mammals observed during the discontinuous 12-year period of the survey, and documented with 242 candid photographs. In the interests of the factual integrity of this study, there has been no attempt at editing or improving the actual record as written up after each day of observation and photography, and pains have been taken to collate the observation notes in the discussion of each species and to correlate them to the interpretation directly without the adventitious aid of graphs, statistical columns and other displayed selective analyses. The photographs have been selected not for their pictorial merit but solely for their evidentiary and record value. Further, brief accounts of the floristic and territorial features of most of the study locations, and references to any climatic factor of special interest, have been provided earlier. When all this has been done, there is neither need nor justification for making the final assessment in this chapter long, and if it seems too brief, it is only because much of what may be detailed here has already been detailed elsewhere in the factual bases specified above, and is not repeated.

The main reason for such a plan is the avoidance, to the extent possible, of personal bias in the assessment of the observation. However, it must be stated that the convictions and experience of many years of faunal and floral observation, and of the factors that influence wildlife in India, have not been ignored, and are also behind this report.

The ecological factors taken into account are not only the climatic, floristic and territorial features, and the inter-relationships of the mammals considered in this report. What is usually termed the biotic factor, i.e., the impact of humanity on wildlife, is of far greater importance than these other circumstantial influences even. This is so overwhelmingly the determining factor in the life of Indian wild animals and

plants today, and has been so overwhelmingly so for the past 50 or 60 years, that it must be the main factor taken into consideration in any ecological report on the wildlife of the country. Giving it the importance that is its due, it will be discussed here as the primary factor affecting wild mammals.

Although this is a report of contemporary influences conditioning the life of some of our larger wild mammals, initially it may be noted that some 60 years ago, in the first decade of the century, the repercussions of human activities on the wildlife were not so serious. Not that they had no important impact on the wildlife then—in fact, even then they were the most important conditioning factors, and from all accounts available, even by the middle of the last century hunting, and trapping and snaring, were being indulged in with little inhibition, and the forests were expected (by natural regeneration) to cope with all demands made on them departmentally and by the people. Decline, in the circumstances, would be mainly a measure of the recuperative powers of the wildlife falling short of the depletion by human agency. In those days, apparently, there were many natural forests and other faunal areas not deeply penetrated by men, and the human population was much less dense.

In the twenties, the decline of some wild animals was noticeable and noticed, and more stringent protective steps were taken, resulting, where the habitats of a threatened species were not exploited by men for forest produce, in an improvement in its status: the special protection accorded to the Nilgiri tahr by the Madras Government and the Nilgiri Game Association is an example of such successful conservation. There were failures, too.

The vital, intimate, delicate and complex interdependence of the fauna and the flora, however, was not appreciated, and only in a very few preserves were forestry operations not carried out, and even in them village rights to exploit the forests were ceded. The natural forests were exploited for timber and other produce, clearfelled in coupes, and areas planted up with commercial indigenous species, and exotics like wattle, eucalyptus, casuarina, cashew and rubber. Private plantations, as of tea and coffee, were concurrently developed, and with the population increasing in and around the forests, the demands of the people on the forests for firewood, thatching grass, and other similar produce, and for grazing their cattle, also increased. Between the twenties and the present, the forests have been deeply and systematically invaded by men.

A century ago, Sanderson writing of the Mysore forests referred to thriving human settlements within the forests having been reclaimed by the jungle, and cited instances. Even today, the vestiges of such abandoned settlements survive in ruins in and around the forests he wrote of, such as Eeranamunti and Moolapura in the Bandipur Sanctuary, and Marasuranagudi in the ¹/₂ Mudumalai Sanctuary. The position has been

completely reversed today. There are few natural forests in the peninsula which have not been deeply penetrated by human enterprise, and apart from the forests having been denuded, or converted into plantations, or having degenerated, they have been occupied and are widely traversed by men. The repercussions on the wild animals of this intensive and deep penetration of their haunts by men, particularly its disturbance value, cannot be overestimated.

Before considering the causes for the decline of forests and wild animals in India briefly, a historical event that has profoundly affected the flora and fauna must be mentioned. After the Constitution of independent India came into force, the Central Government divested itself of such controlling authority as it had over what were, before the event, the provincial forests, and each State gained sovereign authority over its forests. No integrated, mandatory national policy governing the administration of India's forests has been possible, in consequence. Inevitably, in each State the political party in power has not hesitated, within the span of its unrestricted authority, to take steps which seem incapable of being retracted, with regard to its forests. There is little scope for a speculative analysis of motives, and none at all for polemics, in an ecological report, but it may be pointed out, relevantly, that some of these steps, such as the ceding of territorial rights within forests to private parties (as in Bihar and Tamil Nadu), the siting of major projects that affect the area for miles around in or near some of the best faunal areas in the country (as at Parambikulam, Moyar and Ramganga), the increased grant of collection and grazing rights to villagers around sanctuaries and reserved forests, the stepping up of departmental activities within the forests, and similar acts, all have a profoundly depletive influence on the flora and fauna. It is true that these same governments have also set up a number of new sanctuaries and otherwise have shown a consciousness of their responsibilities by the wildlife of their area, but even today there is no recognition of the vital interdependence of the flora and the fauna, and no national wildlife policy that is enforceable, and even in the conferences of the national and State wildlife bodies, the term 'wildlife' is still used mainly to connote the larger wild mammals, or at times these along with the birds and a few other animals, and the flora is considered something quite distinct, a mere setting at best. Further, there is hardly any functional recognition at any level of the prime need for undisturbed living space for the flora and the fauna.

With the enormous growth of the human population and the growth of industries, and the vastly increased and more varied needs of the nation and the people today, the demands made on the forests, wastelands, marshes and other wildlife habitats have also increased and not only in a quantitative manner—these demands have also increased in variety and have a somewhat altered quiddity even when not new. It is no

longer only a question of established forestry practices on a more intensive scale and of the forests being more heavily burdened with village rights. Industries and factories have to be supplied with raw materials (such as bamboo and pulp-wood for the paper and rayon industries) from the forests, land within the forests is found for agriculture, human settlements and resettlements (the Dandakarunya project is an example), factories (munitions factories, for example) and industries are located in and around the forests and also major hydroelectric and other projects. All this has naturally resulted in the forests being further opened up and deeper penetrated, cleared and disturbed.

To the extent to which they disturb, alter and destroy the natural flora and environment of the wild animals and affect their interrelationships, these multifarious human demands on the forests are very much the concern of any ecological report, and for many years I have studied them in various parts of India, but it is unnecessary to enumerate and detail them here. For the purpose of this report it will be sufficient to briefly mention the main consequences of these human demands and activities.

The plains forests have disappeared entirely from many parts of south India and in places I have actually watched their disappearance. In the central and northern parts of the peninsula, there are plains forests left still, some of them dry, open jungles, but everywhere they have deteriorated by human exploitation. Even the hill-forests have been opened up, denuded in places, and deeply penetrated by human enterprise: in many areas they have degenerated. No figures to show the extent of this deterioration and denudation, or the increased extent to which human activities have entered the forests, are available in official records: all that official records can specify is the total forest area in each State, (which, paradoxically, has remained the same for the past 50 years, except for political readjustments and minor cedings of territory), the extent planted up with various species, the selection and clearfellings sanctioned, and similar details. I have, naturally, satisfied myself that the position is as stated by personal inquiry of various State Forest Departments, and the offices of the Inspector General of Forests and the Planning Commission, before making this statement. However, though unassessed statistically, all those with an informed interest in the forests of India know that there has been substantial deterioration and diminution of the natural forests by way of denudation, and degeneration caused by many influences (all related to human activities—some directly depletive, like wood-poaching) in the course of the past 50 years, especially the past 30, the probable extent of such deterioration being a matter of personal assessment and differing in different States. A recent depletive factor that may be mentioned in this connection is that in some States (Kerala, for example) there have been illegal encroachments by private parties, which

have not been successfully resisted : in others, the tendency to cede rights within the forests to private individuals has been more marked in recent years. The extent of such, and similar, loss of forests is small compared to the total area, and negligible from the point of loss of revenue, but the effects of human occupation, which radiate far outward from small centres, have a powerful depletive influence on the wildlife.

Frequent disturbance by human activities has a most unsettling and unfortunate effect on the wild animals, although these activities are not directed towards them and are mainly concerned with the vegetation and terrain. Because of this, the animals may move out from favourable to unfavourable areas, and from protected haunts to areas where they are actively hunted—as one may observe on the outskirts of sanctuaries. When large enough and sufficiently upset by human interference with their normal activities, the wild animals may turn hostile to men, like elephants in places. It is necessary to point out again the multifaceted depletive potency of disturbance, as it is the least appreciated major factor in wildlife conservation in India.

The increasing growth of human settlements in and around the forests leads directly to an increase (whether officially sanctioned or not) of the exploitation of the forests (even in sanctuaries) by humanity for various reasons, such as the collection of fruits and mohwa flowers (B 68 Apr. 16, 70 Mar. 1), firewood (TN 63 Sep. 25—the General Account of the Hazaribagh N.P.), other forest produce such as thatching grass and bamboos, use for passing through from place to place, and cattle droving and grazing (practically ubiquitous, but reference may be made to TN 63 Sep. 25, 64 Apr. 13, 66 Oct. 7, 68 Dec. 11 and 16, 69 Sep. 22, 69 Dec. 12, 70 Sep. 15 and Oct. 3; K 70 Apr. 20 and AP 68 Nov. 6 to 13). Apart from cattle competing with the wild herbivores for fodder and water, the practice results from time to time in the communication of infections from cattle to the wild herbivores, such as rinderpest and foot-and-mouth disease with disastrous consequences (MY 68 Oct. 5—notes on gaur, sambar and chital).

Officially sanctioned collections of minor forest produce for departmental sale, are most deleterious in their impact on wild animals, and where the collections are intensified (as in Madhya Pradesh), naturally the harm they cause to wild animals is also intensified.

The spread of exotics into the natural forests is directly related to their opening up by human activities, and has in some areas resulted in serious ecological imbalance. Practically all exotics specially cultivated departmentally, such as casuarina, cashew, rubber and *Prosopis juliflora*, serve to deprive the wild animals of territory in long-held homes, but none of these is as inhibiting in this regard as the species of Australian wattle and eucalyptus assiduously cultivated departmentally. Curiously enough, some of the exotics accidentally introduced into the forests and

countryside do not have an adverse effect on the wild animals. The most notable of these today is the lantana which, in places, offers congenial cover to the animals (TN 62 Sep. 12), though as fodder it is of much less importance—elephants, gaur and chital eat it desultorily when it is in fresh leaf. Iodine-rich *Eichhornia crassipes*, eaten in small quantities by some animals (MISC 68 Feb. 4) may, or may not, have some ultimate effect on those animals. Many plants of the Compositae have entered deep into the forests and appear to be only a hindrance to the wild mammals.

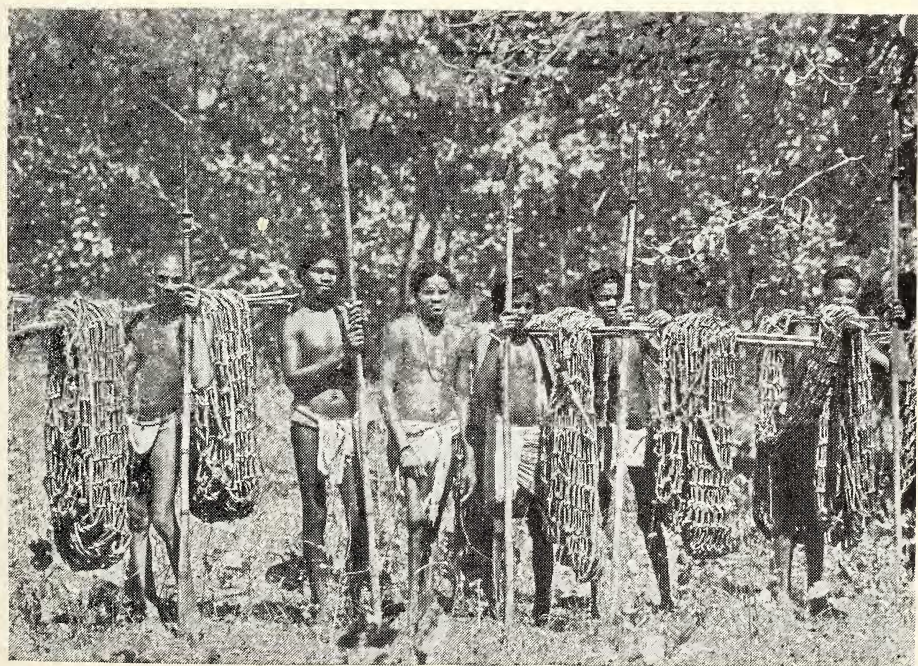
The harm from pollution, where factories are located close to faunal areas, and the lethal effects of insecticides on animal life, have been widely appreciated in the West, and it is possible this realisation might spread to India, too.

The main depletive factors have been mentioned. For two reasons, they have gained increased potency in recent times, first, because the increase in human population has led to greater human demands on wild-life habitats, second, because the decrease in the flora and fauna progressively limits the recuperative powers of the wildlife. For this second reason, I think that it is not the comparatively recently developed depletive factors that are currently most hostile to wild animals, but the oldest factor, going back to prehistoric times, hunting.

By hunting is meant, here, all modes of encompassing the death of wild animals, by licenced shooting, unlicensed shooting, snaring, netting, baiting, trapping, and organised hunting with bows and arrows, or spears, or both. Because the forests have been opened up and there are few inaccessibly remote retreats left for the wild animals, because the animals have less living space and are therefore easier located, and because protection (however justified the cause of its poverty) is poor, hunting has increasingly assumed a quite menacing depletive potency. No evidence can be adduced in support of my view, but I have studied this problem for years and in many places, making inquiries of poachers, trappers, and many tribals, and I think professional meat-hunters, tribals indulging in regular orgies of hunting (MP 70 Mar. 27—photograph MP 40) and amateur poachers (many of them high-placed in status) are doing much greater damage to the wild animals today than is generally appreciated.

From inquiry made, the main cause for the notable decline of wild animals in areas formerly celebrated for their fauna (in Andhra Pradesh, Orissa and Madhya Pradesh, for example) seems to have been poaching by shikaris with guns and tribal hunting with less sophisticated but still lethal weapons and nets. Among tribals, hunting is mainly dependent on the traditions of each tribe; the tuber-eating Khadias of Orissa, for instance, do little hunting, while in the same State, Kols and Gonds indulge avidly in it. In general it may be said that tribals in the south of

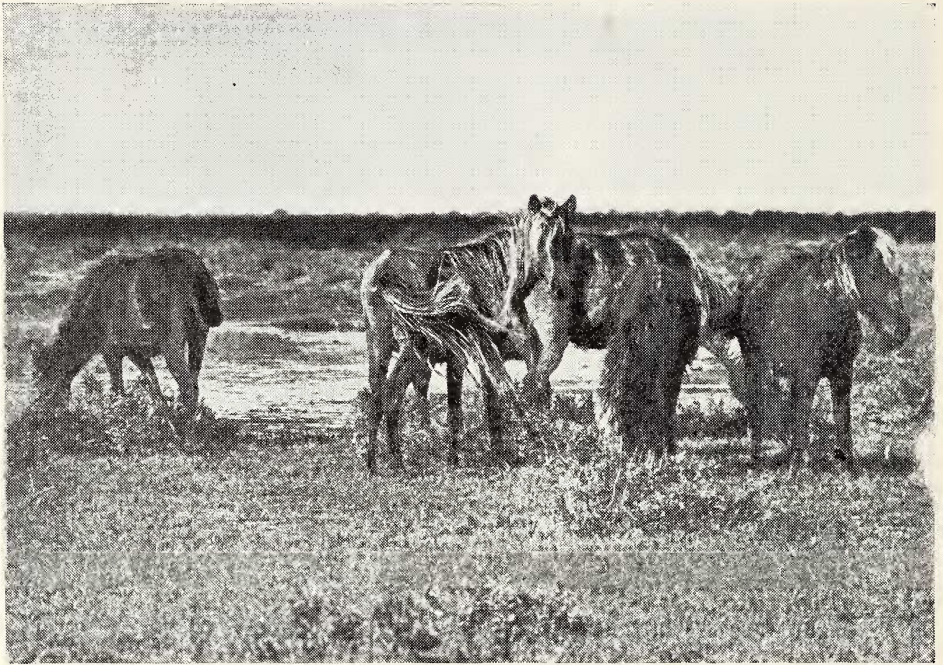
Krishnan : Mammals



Above : BIHAR 1968 : HAZARIBAGH N. P. : April 16 — dawn : Men picking fallen flowers from under a mohwa tree — B.1 ; *Below* : M. P. 1970 : BASTAR : March 27 : About 9 a. m. at Mukhaveli : Muria hunters, with nets and spears — MP. 40.

(Photos : M. Krishnan)

Krishnan : Mammals



Above : TAMIL NADU 1969 : PT. CALIMERE : December 18 — p.m. : Feral ponies — TN. 58 ; *Below* : BIHAR 1970 : BETLA : PALAMAU N. P. : February 22 — 1 p.m. : Rhesus at Madhuchuan — B. 32.

(Photos : M. Krishnan)

the peninsula are less given to hunting than those in the north, but no such regional bias governs poaching. It is practised everywhere.

The most obvious reaction of wild animals to sustained disturbance by humanity (and especially to hunting, which panics and unsettles them even when it does not succeed in killing them) is to convert them into shy, fugitive creatures of the night, and to cause them a greater degree of nervous tension than is normal in their lives. Animals which are normally abroad by day, like gaur, sambar and pig, retreat into cover with dawn and stay in hiding till near sunset: the difference between the behaviour of gaur in the Mudumalai and Bandipur Sas. and in Kanha N.P. is significant. Disturbance also leads to loss of the best feeding grounds and of safe waters (poachers usually sit up over the only available water within miles—MP 70 Mar. 27 and 31) and generally to a decline in animal populations.

Many animals have declined dangerously or become locally extinct within the past 20 years. Only the decline of one of them, the tiger, has excited popular interest here and abroad and been widely publicised. It is not as if the tiger became rare in India overnight: experienced men like Corbett predicted its decline over 20 years ago. When even the decline of the tiger, which has captured human imagination in India for some 2000 years, was noticed only at the last stage, it is only logical that the decline of less glamorous animals like the liontailed monkey, the sloth bear, the hyena, the wolf and the dinky little Indian fox has gone largely unnoticed, and even the local extinction of some of these, and the blackbuck and the leopard in areas. In fact, all the mammals mentioned in this report (and a good few comparatively rarer mammals not mentioned here) have declined noticeably in numbers excepting the elephant, the chital and the pig: of these three, the seeming thriving status of the elephant is almost certainly illusory, as pointed out in the note on the animal, and though it is protected today (and has been so protected for years) all over India, I predict that within a generation elephants, dispossessed of territory, are likely to be so much in men's way that in many areas they will be proscribed and destroyed.

This apathy to the dwindling of wildlife till the last stages of decline are reached is by no means peculiar to our country. In America and Europe, too, the people and the administrations awoke to the imperative need to preserve wildlife only after having lost much of it (more than we have), some species, like the American bison, by active hunting. Whether we will benefit from the experience of the West and save and revive what is left of our wildlife is a question to which no definite or succinct answer can be provided, and anyway the answer is clearly beyond the scope of this report. However, it may be said that in our national culture there is no scientific interest in nature. In our languages we do not have specific names for many plants and animals, and not even terms to

distinguish the antelopes from the very different deer. Further, being preoccupied with national development and the many pressing consequences of overpopulation many people find it hard to appreciate the importance of something that offers no immediate, tangible benefit. Even in the West (where natural history had its origin and growth), it was only after the disillusionment and shattering of normal human values by war, that people came to realise that wildlife provides something much greater than recreation or aesthetic satisfaction, that it provides a fascinatingly varied, entirely natural and authentic, and vital interest in human life. Further, as pointed out already, we have the problem of national integration of the country's wildlife effort.

The next ten years are critical.

GENERAL ACCOUNT OF THE MAMMALS STUDIED

The order of arrangement follows the BOOK OF INDIAN ANIMALS by S. H. Prater (2nd edition, 1965) and the nomenclature, following that book, the CHECKLIST OF PALAEARCTIC AND INDIAN ANIMALS, 1758 to 1946, by Ellerman and Morrison-Scott (1951).

THE BONNET MONKEY

Macaca radiata (Geoffroy)

(Summary of field notes: Observation records: 22.)

Locations: Forests 19: Mudumalai Sa., Ranganathittoo Sa., Bandipur, Point Calimere. Temple—3, Sholinghur.

Photographs: MISC 1, TN 47A, TN 60.)

This is much the commonest monkey of what used to be termed the Deccan, and south India, and commoner in and around rural and suburban areas (in scrub jungles, around villages and towns, and around certain shrines and railway stations) than in interior forests. However, the meagre record of it in the field notes exaggerates this comparative scarcity inside forests, and is partly due to my having ignored bonnet monkeys seen in tree forests, on occasion, in the preoccupation with some other animal. It is found in deciduous forests (MY 68 Oct. 6 & 18, 69 Oct. 9 and TN 70 Sep. 29) and I have seen it in the tall tree forests of Karwar and also in semi-evergreen forests, as in Courtallam. C. G. Webb-Peploe (*JBNHS*, Vol. 46—No. 4, p. 629 *et seq.*) reports its occurrence in the semi-evergreen forests of Naraikkadu in South Tirunelveli, along with the liontailed macaque. However, it is not a typical forest animal, and is rare or unknown in many montane forests.

Size: Morphological characters

As in other macaques, adult size is extremely variable. Prater gives the weight of a full-grown male at 13-19 lb. and of a female between 7 and 8 lb. The superior size of the male is more evident in macaques than in langurs, but in no troop of this monkey seen was a dominant male so much bulkier than the largest female that its weight could have been more than twice the female's; further, even in animals of fair average size, the difference in weight between adult females is often greater than 1 lb.

Though the male is considerably larger than the female in adulthood, in this macaque variations in size independent of sex but based on locality and genetical factors can be even more pronounced. This difference in adult size between troops in different area does not seem to be dependent entirely on environment, but to be more complex.

It is not in dense forests, but in comparatively open country, in low-elevation hills and around shrines and human settlements, that the bonnet macaque attains its best development. The food advantages of such locations are obvious and probably the sustained intake, over generations, of more nourishing food than is available naturally in the forests has contributed to the physical superiority of this monkey where it is, in a large measure, dependent on humanity for its sustenance, but such a logical explanation does not account for the fact that where it is dependent on humanity, it is smaller in some areas than in others: for example, the size attained in Tirupathi, Papavinasam and Jalarpet is not reached at other shrines and railroad communities in the same region. Forest-living monkeys are generally smaller than those in rural and urban areas, and they seem to reach a larger size in the eastern regions of their range than in their western range.

What is specially interesting about this macaque is that even in the same area, it may display considerable variations in size from troop to troop. In the Mudumalai sanctuary of Tamil Nadu Wynaad, the bonnet monkey is mainly found in a few troops in the Theppakkadu-Kargudi areas, and is typically the smallish, rather furry forest-living kind. Typical specimens are shown in photograph TN 60. However, in the interior forests, a miniature bonnet monkey was noticed, hardly half the size of the commoner specimens around the human settlement at Theppakkadu, so fugitive in its response to humanity that it was not possible to observe it closely or for any length of time, and that only one clear picture of it could be taken (TN 59 Mar. 23, 1963 Sep. 28, 66 Sep. 27 and 69 Oct. 5). An adult female was seen carrying an infant only the size of a loris (TN 62 Mar. 25). The photograph (TN 47 A) shows the small size of 2 'miniature' bonnet macaques in relation to the fresh leaves on the culms of the giant bamboo.

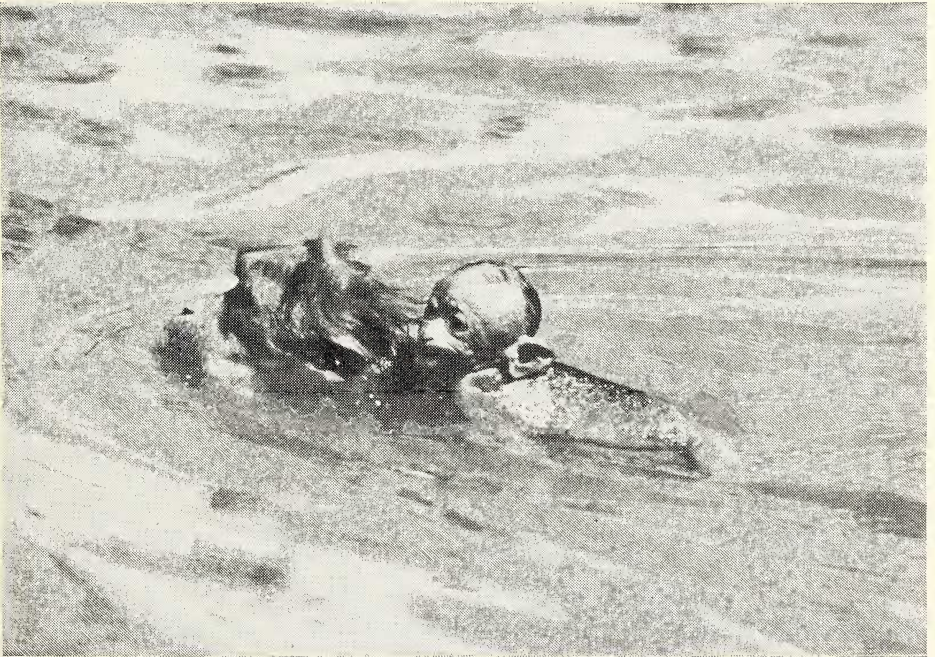
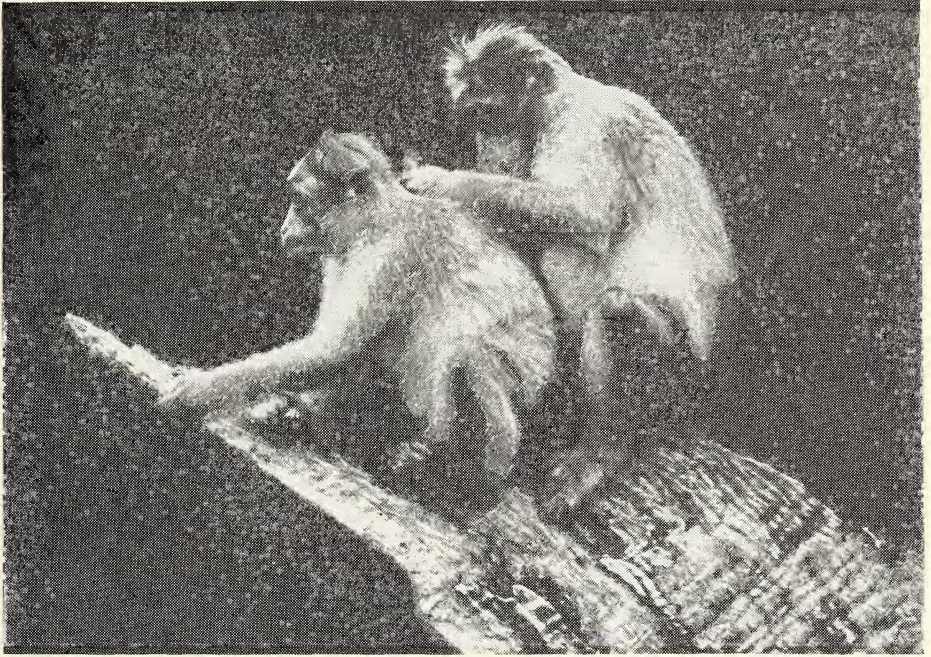
Distribution

The distribution is limited to peninsular India well south of the Gangetic plain. Prater gives the northern limits of the bonnet macaque as up to Bombay on the west, and the Godavari on the east : it may be added that in the central part of this peninsular wedge, in the northern tracts of Andhra Pradesh, its range does not quite reach the river. Within the vast area of this peninsular wedge, its distribution is somewhat discontinuous : it is absent in some natural forests (and also in some rural areas). Although less likely to be deprived of territory by human occupation of the plains forests than most other animals, since it adapts so readily to life around human settlements, it seems to have lost ground in places, but probably this loss has been compensated by the acquisition of new territory elsewhere. An interesting example of such conquest is provided by its introduction, by capture and release, into the coastal forests of Vedaranyam, near Point Calimere. In April 1965 some 30-odd monkeys, captured around Kumbakonam, were brought to the Kodikadu Reserved Forests and liberated : they are thriving in several troops now, with a total population of about 100, and have perhaps been helped in this by the absence of predators in the area.

Habits : Behaviour

A notable feature of the social organisation of the bonnet monkeys of various areas is that in natural forests they are usually to be found in small groups of from 3 or 4 to a dozen or so, and never in large numbers. They are shy of men in the forests, even fugitive, and spend much time in treetops. The big troops are to be seen in specially congenial areas where they are partly or mainly dependent on humanity for food, as around shrines and railway stations. In such places, a number of troops, probably composed of smaller units, live in loose associations where tolerance of one another within limits, and individual displays of threat and dominance, are observable in a complex, rather than in a pattern. It is noteworthy that with the change in feeding habits, from the industrious seeking for small titbits that is typical of life in the natural forests, to plunder and the quick picking up and thrusting into the cheek pouches of scattered human surplus food, they are much more terrestrial and swift-moving, and often gain noticeably in size and power. In the forest they spend much time in finding food, climbing trees to feed on leaf-buds and fruits, patiently combing the seeding heads of grasses with their lips to strip the seeds, hunting insects, or investigating plants growing in the interspaces between rocks for insubstantial fruits and buds ; even when food, such as the tender new leaf of the tamarind, is available in bulk, forestside bonnet macaques feed methodically, filling their cheek-pouches slowly and not stuffing them hurriedly. The vegetarian food includes the leaf-buds of the giant bamboo and the leaf-buds and foliage of many

Krishnan : Mammals



Above: TAMIL NADU 1970: MUDUMALAI SA.: Theppakkadu: September 21 — p.m.: Bonnet monkey grooming young — TN. 60; *Below:* MISCELLANEOUS: Sholinghur, TAMIL NADU: 1960: May 24 — p.m.: Bonnet monkey mother swimming with her young on her back — MISC. I.

(Photos : M. Krishnan)

Krishnan : Mammals



TAMIL NADU 1966 : MUDUMALAI SA. : September 27 : Bonnet Monkeys — TN. 47A.

(Photo : M. Krishnan)

shrubs and trees, a variety of fruits including green fruits, and the seeds of grasses (TN 62 Mar. 13, 62 Sep. 13, 63 Sep. 13, 69 Dec. 12, 70 Sep. 29). Grubs, insects and other such small prey are also part of the diet, and birds' eggs when available. They eat the eggs rather clumsily. A group of 7 swam across the Kauveri where it was both deep and fast-flowing to a chain of islands on which water-birds were nesting in a packed colony, to raid the eggs from the nests; incidentally, a crocodile was known to frequent the neighbourhood of these islands (MY 67 Aug. 14).

Many distinctive vocalisations, attitudes and gesticulations are used in communication, and expressions of dominance or submissiveness, threats and demonstrations. Among the main vocalisations may be mentioned the rattling, reverberating 'krrrrr', well-known as the threat and anger call, and a soft short grunt, used in intraspecific communication when the monkeys are on the ground in company and moving through the undergrowth. A vocalisation I have heard on several occasions in the field, but never seen recorded in the literature available to me on this monkey, is a low, bird-like, cooing 'pio', reminiscent of the similar call used by the liontailed macaque. Prater, writing of the Assamese macaque (*Macaca assamensis*) mentions 'a rather plaintive musical call, a low "pio"': never having heard the Assamese macaque, I am unable to say whether this particular vocalisation of the bonnet macaque is similar, but the quotation from Prater would be a good description of this call as well. There is only one mention of the call in my field notes (TN 69 Dec. 12), but as said, I have heard it several times, and outside the period of this survey have also heard the similar call of the liontailed macaque in the wild.

A loud, sustained choking sound, difficult to describe in words except by a contradiction in terms, as a guttural screech, is used in intraspecific combats, and the same sound or a variant as the alarm call. Bonnet macaques come out with this call in frenzied repetition at the sight of a leopard or other predator, but are less unvarying in this than the langur. When up in trees and apparently when confident that they have not been seen, they may remain silent when a predator passes below them, hugging the bole and hiding in foliage.

When walking on the ground, without being excited or alarmed, the distal third of the long tail is trailed: naturally, other Indian macaques, which have short tails, never do this, but on occasion the Common Langur does so: however, the trailing of the tail along the ground in this manner is more usual with the macaque than with the langur.

Although highly arboreal, the bonnet macaque does not bound about the branches, or leap from treetop to treetop, in the manner of the Common Langur. However, in swarming up trees, sheer rock faces and walls, it is even more expert than the langur. At Courtallam, in April 1967, K. Krishnamoorthy showed me a vast, sheer rock-face up which he had

seen a troop of some 30 bonnet macaques go swarming, clinging on to minute holds, an impressive performance.

This monkey is a good swimmer and, like the rhesus, takes to the water to get across from one bank of a pool to the other instead of taking the circuitous path around along the bank. It can enter the water very smoothly when it wants to, and swim submerged for short distances. Females carrying infants also take readily to the water, the young shifting from the abdomen to the shoulders to ride piggy-back and keep above the surface of the water (Photographs MISC 1 : notes MISC 60 May 24 ; MY 67 Aug. 14, 69 Oct. 9 ; TN 69 Dec. 12).

In biting their opponents (especially during intraspecific combats), the bonnet macaque, like all monkeys, seizes its adversary with both hands and pushes it at the moment of biting, thereby inflicting a quick, tearing wound that can be quite grievous (MISC 60 May 24).

Forest-living bonnet macaques favour the neighbourhood of large rivers and waterfalls.

There seems to be no defined breeding season in the wild and infants are seen both in summer and in September-October. An adult female with 2 infants is seen occasionally, but in such cases it is not known whether these are twins, or one is an adopted infant whose mother is no longer with it. The usual rule is one young at a birth.

THE RHESUS MONKEY

Macaca mulatta (Zimmermann)

(Summary of field notes : Observation records : 10.

Locations : West Bengal—Jaldapara Sa. : Orissa—around Balimela : Bihar—Palamau, Karkatnagar.

Photographs—B 32.)

The rhesus replaces the bonnet macaque as the commonest monkey of the country north of the Godavari. In places it is to be found in large numbers around shrines, railway stations and human settlements, but all records in the field notes are of forest-dwelling rhesus.

Size : Morphological characters

As in the bonnet macaque, size varies considerably with locality, and in adulthood the male is considerably larger than the female. It is easily distinguished from the bonnet monkey by the hair on the crown having a backward slant with no parting, instead of being arranged in a radiating 'bonnet', the shorter tail, and the more chunky build ; the burnt sienna to brownish orange colour of the pelage on the rump and lower back is distinctive—for the rest, the coat is an olive-grey, and the skin of the face and ears pink, as in the bonnet monkey. The two are of more

or less the same size, and Prater gives the weight of the rhesus at from 10-14 lb. Within peninsular India, the rhesus also seems to attain its best physical development in areas where it is dependent on humanity for food. It is said to reach its maximum size in the sub-Himalayan region. Rhesus observed in Bihar were small-sized and almost olive-brown in colour (B 68 Apr. 22, 68 Apr. 25, 69 Feb. 20, 69 Mar. 2).

Forest-living rhesus are generally small, and in certain forests a few seem to decline to a miniature size, as in the bonnet macaque. In the Jaldapara sanctuary I saw a group of 4 such miniature rhesus (MISC. 65 Oct. 23).

Distribution

The rhesus has a wide distribution outside peninsular India, in the sub-Himalayan forests, Uttar Pradesh, West Bengal and Assam, and farther east into Burma and beyond. Prater gives the southern limits of its territory in peninsular India as the Tapti on the west and the Godavari on the east. In northern Andhra Pradesh it is to be found a little further south than the Godavari. In Orissa, Bihar and Madhya Pradesh the distribution of the rhesus is widely discontinuous. For example it is not to be found in the Hazaribagh and Kanha parks of Bihar and Madhya Pradesh. One probable explanation for this is that with the exception of the liontailed macaque and the Nilgiri langur, the macaques and langurs of peninsular India are all creatures of the deciduous forests and do not occur in evergreen tracts. For this reason the rhesus will not be found where sal dominates the flora. It is true that neither in Hazaribagh nor in Kanha does sal occur in dense continuous belts, as it does in the Simlipal hills of Orissa; I have not seen the rhesus in the Simlipal hills either, but my acquaintance with their sal forests is limited to 7 days spread over 3 years.

Habits: Behaviour

Although it climbs trees and rocky escarpments expertly, the rhesus is much more terrestrial than the bonnet macaque, especially when feeding. It takes readily to water and is a powerful swimmer. A troop of 19 was observed in the Palamau N.P. (Bihar), clinging on to the low steep banks of a pool, using one hand to fish out an alga from the water, and eating it (B 70 Feb. 22; photograph B 32). Forest-living rhesus spend much of their day searching for food assiduously, eating leaves, buds and insects, and similar insubstantial morsels. In their feeding habits they are similar to bonnet macaques, but noticeably less arboreal.

In their vocalisations, too, they are somewhat similar, though except when screeching and grunting during intraspecific fights and disputes (bonnet monkeys also indulge in this while fighting) they seem to be less vocal. They do not have the low, musical 'pio' call, used by bonnet monkeys in treetops. Breeding is not limited to a defined season,

THE LIONTAILED MONKEY

Macaca silenus (Linnaeus)

(Summary of field notes: Observation record: 1

Location: Varagaliyar, Anamalais.

No photographs.)

The liontailed macaque has the most restricted distribution of all Indian monkeys, being confined to a few evergreen forests of the Western Ghats in Tamil Nadu and Kerala. It has been much depleted over the past 50 years by systematic poaching for the sake of the pelage and flesh of the adult, and the capture of the young for sale as live specimens. In hunting this monkey and capturing the young, slings and bows are usually used; the mother is killed or wounded so severely as to be incapable of flight, and the infant then captured.

Some 35 years ago I have seen it, and observed it closely, in the evergreen forests of the Thirunelveli district around Courtallam: it is no longer to be found in this location, or in some other locations where it was known then. Its current status is adequately described by the word 'precarious'.

Size: Morphological characters

The size of this forest-living monkey is approximately that of the other two macaques of the peninsular area, the bonnet macaque and the rhesus, but is even more variable among adult individuals; the superior size of the male in adulthood is noticeable in this species also. The build, especially in adults, is more thickset than in the other macaques.

The sleek black coat and the luxuriant ruff of long, warm grey hair around the black face, forming almost a mane, are the distinctive features of this monkey; the short tail is not leonine, ending only in an inconspicuous tuft.

The only other black monkey of India (excluding the only ape of the country), the Nilgiri langur, is also usually found in evergreen forests inhabited by the liontailed macaque. Both are arboreal, and the langur also has a warm grey ruff, more brownish grey and less luxuriant, but these details are hard to distinguish in the treetops, as also the more reachy build of the langur. The much shorter tail of the macaque, and its quieter movements, serve to distinguish it from the langur.

Distribution

Prater gives the distribution as the Western Ghats from North Kanara southwards to Kerala. It seems to have died out in its northern range and to be now limited to its southern reaches, as already said. It is essentially a seclusive monkey of the deeper evergreen forests.

Habits : Behaviour

The liontailed macaque is found well away from human settlements, in small parties of from half-a-dozen to a dozen or more. It feeds both in treetops and on the ground, and is similar in its feeding habits to the bonnet macaque. It is more deliberate in its movements and notably less vocal. The only sounds heard in the wild were a rather bird-like intraspecific call (also heard in the Calcutta and Madras Zoological gardens), louder than the musical 'pio' of arboreal bonnet macaques but similar to it (MISC 60 Apr. 30), and a soft grunt. I have heard these calls on several occasions, long prior to the period of the present survey, in the wild : they can also be heard where a number of these monkeys are housed together in a zoo. Webb-Peploe (*JBNHS* 46 : 4, 629 *et seq.*) reported that in the evergreen forests of Naraikkadu, South Thirunelveli, these monkeys were seen in a troop of about 20, that they were shy of men and deliberate in their movements, and descended from one tree to climb another instead of proceeding along the tree-tops, and that they were feared by the langurs (presumably the Nilgiri langur) and bonnet monkeys ; he records two calls, a subdued grunt and a loud, pigeon-like 'coo'. Prater (whose book is mainly a compilation), presumably following Webb-Peploe in part, gives this account of vocalisations: 'The call of the male is said to resemble the human voice. It is compared to the "coyeh" of a man trying to get in touch with his lost companions in the jungle, and again to the loud "coo" of a pigeon'. It seems extremely unlikely that a highly gregarious animal like this macaque should have occasion for a penetrating 'coyeh' as of a man calling to lost companions, and I have never heard this call, but in view of the narrow limitation of my personal knowledge of this monkey, made diligent inquiry of tribals in the Anamalais, and the Periyar area of Kerala, who knew it in the wild much better, being those who poached it for pecuniary gain, and they, too, said they had never heard the call, but only the bird-like 'pio'—in fact they locate their quarry when hunting it mainly by this call. As to this call being like the loud 'coo' of a pigeon, the question is which particular pigeon's 'coo' it resembles : if it is the polysyllabic modulated call of a green pigeon of the genus *Treron*, the further qualification may be added that the macaque's call is also modulated and less polysyllabic, being like a phrase of the bird's call rather than the entire call.

THE COMMON LANGUR

Presbytis entellus (Dufresne)

(Summary of field notes : Observation records : 76.

Locations : Tamil Nadu—Mudumalai Sa. ; Mysore—Bandipur ; Orissa—Balimela, Raigoda Sa. ; Bihar—Palamau N.P. ; Madhya Pradesh—Kanha N.P. ; Churna ; Maharashtra—Taroba N.P. ; Uttar Pradesh—along the Sharada canal.

Photographs—TN 17, 43 ; MP 8, 33 ; MR 1, 2, 4, 15.)

The grey langur (Common Langur) is the only Indian monkey with a distribution all over India, from the Himalayas to Kanyakumari. Taxonomists have recognized a dozen territorial races within the peninsula, based, among other considerations, on the colour of the hands and feet. Summing up these distinctions, Prater says that the contrast between the white ruff around the face and the darker hair of the body, vivid in Himalayan specimens, is less apparent in peninsular animals, but that 'among them there is variation in the colouring of the hands and feet' which, 'are almost black in langurs from the plains of northern India, become paler as one travels southwards to the Deccan, and are almost white in the dry zone of south-east India'. Perhaps this entire question of races is due for a revision by competent taxonomists. A search for one of the white-handed races described in Blanford's fauna, in the locality of his type-specimens, proved infructuous, the langur seen being black-handed. Further, the darkest grey I have seen in the pelage of this monkey was a langur seen along the Sharada canal in Uttar Pradesh (MISC 68 May 21).

Size : Morphological characters

This langur attains its maximum size and richness of pelage in the Himalayan region. Prater gives the weight of peninsular animals as from 20 to 35 lb.

The grey langur is much taller and heavier than any of the macaques of the peninsula, with the comparatively slim, long-limbed build of its tribe, and a long tail ending in a white-haired tuft, usually in a conspicuous tuft. The difference in size between the adult male and female is much less obvious than in macaques, and size variations among adults in a troop are also less flagrant.

The question of size in comparison to other species of the genus is interesting, the race occurring in or around each of these other species being taken into account. The grey langur is relatively larger than the golden langur (MISC 68 February 15) and perhaps longer than the Nilgiri langur, but slimmer built.

The basal third of the tail is muscular, and the tail is often carried gaily, though the distal half of it is lax and pendent. In adulthood the tail

is not prehensile, but in infancy it is, and the infant being carried clinging to the abdomen of its mother loops its tail around the base of its mother's for an additional hold when being carried at a run (MR 68 November 18). The infant langur is black or a very dark grey at birth, but the hair on its coat turns to a pale grey in the first month of its life : apparently the transition is swift, for though I have looked for it, I have not seen young animals in an intermediate stage of this change of colour (TN 59 April 3, 66 April 2, 5, 6 ; MP 69 March 9, 21, 70 March 15, 20). In the bonnet macaque, too, the newborn young is dusky or black. Has this dark colour of the infant changing abruptly to pale grey any phylogenetic significance or is it purely an ontogenetic change? (Photograph MP 33).

The grey langur is typically the monkey of deciduous forests and the total number of observation records of it, exceeding twice the sum total of such records of all three macaques mentioned, in the field notes, is a true reflection of its commoner occurrence in the forests, for it was ignored even oftener than those macaques.

Prater, following faunas, mentions that it is to be found throughout India 'except the western deserts'. This statement needs amplification and addition. Not only is the langur not found in desert regions, but it is also absent from the indeterminate peripheral scrub that has become such a feature of human occupation of the plains forests in India over the past three decades, being essentially a forest monkey.

A further factor conditioning its distribution, also caused by human agency, is that in places it has been killed out, or so harried by men that it has left the area. Tribals hunt the grey langur for its flesh, and its flesh is also in demand for the sake of the therapeutic potency attributed to it superstitiously. In Sholinghur, where this langur was common, it was wiped out by hunting within half-a-dozen years (MISC 60 May 24).

A purely natural factor, also limiting the distribution of the grey langur, is that it is essentially an inhabitant of deciduous forests (including dry deciduous forests, like Betla in Bihar) and does not enter true evergreen forests. In northern peninsular India, where sal is practically the only evergreen species of ecological importance, such forests occur in sizeable belts rather than in patches, and there is no monkey peculiar to the evergreen tracts. In areas where sal occurs in patches, as in the Kanha N.P., the grey langur is common in the areas around, but not in the Hazaribagh park.

South of the sal areas of the peninsula, the floristic ecology is quite different. A great number of evergreen tree species, not totally unmixed with deciduous species (in fact, in places sal grows so gregariously that the deciduous 'sal associates' are much less common than in southern evergreen forests), form patches and belts of evergreen and semi-evergreen forests, some of them of comparatively low stature and at comparatively low elevations, dependent largely on rainfall and edaphic factors—we

have sholas and patches of evergreen forest. The grey langur is not found in them, though the Nilgiri langur is quite frequently. A fuller account of this interesting question of floristic ecology determining distribution is provided in the note on the Nilgiri langur, but it may be said here that in peninsular India today all the man-imposed and natural factors mentioned serve to render the distribution of the grey langur highly discontinuous.

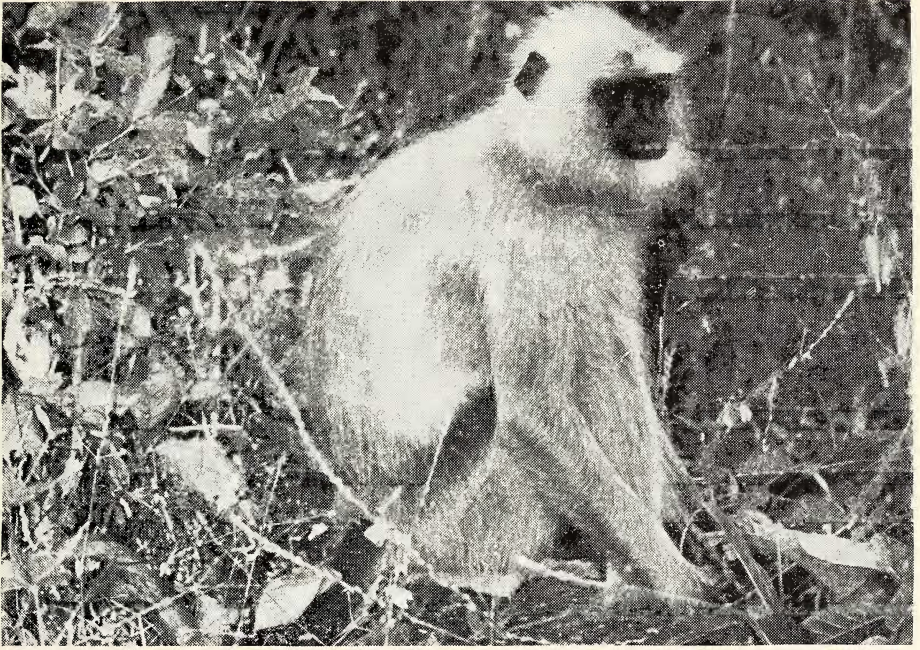
Habits : Behaviour

Like all Indian monkeys, the langur is gregarious. In the forest areas selected for this survey, it was seen in parties of from 4 to 18. On occasion, large troops of from 18 to 36 were seen feeding together in the treetops on the sprouting leaf-buds or on fruits, or feeding on the ground, but these were obviously composite troops of 2 or more parties, and split into parties in their getaway on being approached (TN 66 April 9, 69 October 4; MY 68 October 24; MR 68 November 29). At other times, a single langur, or 2 or 3 together, were seen, but presumably there were other langur not far away (TN 62 April 4; O 69 January 14 & 21).

3 separate parties of langur more or less resident in Lower Kargudi (Mudumalai Sanctuary) were noticed from time to time during April 1966; these kept apart and did not mingle, though at times they were very close to one another—it was possible to identify these parties easily by the difference in age between the young in them, and by one containing 2 adult males, another 1, and the third none (the field notes provided here do not contain a detailed record: TN 66 April 2, 3 & 6). A party of 15 observed in the Taroba N.P. in November 1968 was still together a year later, though increased to 19 by new births (MR 68 November 18 & 69 November 26).

In parties with a more or less fixed composition, no defined pattern of dominance by one adult male was evident unvaryingly. A party of 9 observed consisted of an adult dominant male, 5 adult females two of which had months' old grey young with them, and another adult male which was of the party but not in it, keeping to the periphery and avoiding the proximity of the dominant male; this second male was restive and aggressive, and made several threatening advances towards the groups of females and young. The dominant male ignored him, not even indulging in a threat gesture, but on one occasion when this 'rogue male' threatened one of them, 4 adult females joined together and chased him away (TN 66 April 2 & 12: Photograph TN 43). In another party of 11, the dominant male, a big langur with a kinked tail, was relaxed in the fork of a teak, while up another teak a pair of young adults sat very close, a male hugging a female, using both hands and a leg to hold her; for over an hour he just sat there hugging the female, with no overt sign of sexual desire, hardly moving (TN 62 March 30).

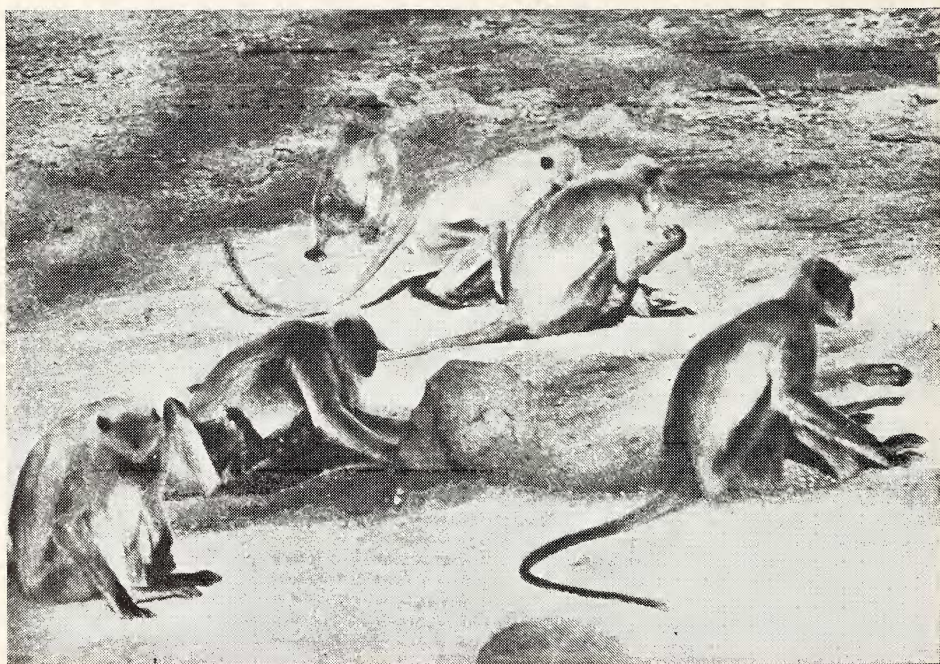
Krishnan : Mammals



Above : MAHARASHTRA 1968 : TAROBA N. P. : November 16 — about 11 a.m. : Adult female langur — MR. 1 ; *Below* : MAHARASHTRA 1968 : TAROBA N. P. : November 18 — a.m. : A langur mother nursing her young — MR. 2.

(Photos : M. Krishnan)

Krishnan : Mammals



Above : MAHARASHTRA 1968 : TAROBA N. P. : November 22 — around noon : Langur drinking — MR. 4 ; *Below* : M. P. 1970 : KANHA N. P. : March 15 — p.m. : Langur at Sravantal lick. Note black baby — MP. 33.

The young langur stays close to its mother even after it is half-grown, and even when well able to run and climb, rushes to its mother at the least alarm and is carried by her, clinging to her abdomen. Mother langur suckle their young for quite a long time—one infant was suckled for nearly 11 minutes (MR 68 November 18 : Photograph MR 2). When they do not want their young to stray from their side, females restrain their young by holding on to their tails, just above the tip : I have seen a mother langur drinking at a puddle, while holding the tip of her progeny's tail in one hand. Bonnet macaques, which also have long tails, use the same hold to restrain their young.

The normal walk is leisurely and easy, and at times langur even creep silently through the undershrub. But when bolting in alarm, their bounding run has a somewhat laboured and exaggerated action, with the palms, and the soles of the feet, slapping the ground audibly. They are very much at home in trees and can move along branches and climb smoothly, but when scaling a steep rock or going up the bole of a tree, usually go up in a few bounds, and often bound along the boughs with sure-footed, energetic speed, shaking the foliage and twigs with the exuberance of their progress. No doubt their size and weight account for this in part, but for the rest it is the exuberance of their movements.

Their acrobatic leaps from treetop to treetop have been commented upon by every observer. To gain momentum for the leap, they run along the bough with a down-pressing action, so that the upward lash of the branch at the moment of taking off adds propulsion to their leap. Many observers have commented on the predisposition of the grey langur (and other monkeys) to leave the safety of the treetops and descend to the ground, where it can be overtaken, when pursued by an enemy. This might be due to the desire for concealment as an escape. This langur will, when closely watched, draw the foliage of the tree it is sitting on around itself, to hide its face, an action that seems peculiar to it. Langur sitting in a tree bare of foliage will leave it at once when approached by a man, whereas where the tree has a leafy crown, they may stay on (TN 66 April 9).

The thick, calloused skin on the palms and the soles, and the sitting pads beneath the tail, enable langur to climb trees and run on the ground energetically, as well as to sprawl at ease in repose. The attitudes assumed by them during their midday siesta in treetops are often extremely relaxed, and both on the ground and up a tree a favourite rest-position is to sit on the subcaudal pads, with the tail hanging limp or stretched on the ground behind, with both hind legs stretched out in front and elevated, resting on some support (such as a branch or a stump) at the level of the shoulder, with the arms resting on the legs (TN 62 March 30; MR 68 November 27).

Their roosting behaviour is interesting. A suitable tall tree is selected,

probably one already used many times, in the vicinity of where they have been feeding in the evening, and towards sunset the langur repair to it singly and in twos and threes, and climb up to a stout, leafy lateral branch on high. There is much vigorous agitation of the boughs during this ascent to roost, but not many noisy wranglings—the agitation of the branches is, presumably, a territorial staking of claim, but it does serve to dislodge debris and dead leaves and twigs from the tree, and possibly unwelcome earlier occupants, though it is a purely instinctive action. All the langur have ascended by nightfall and thereafter they roost in tight company, in one or two groups, on the selected branch or branches. They are so completely hidden by foliage that only their pendent tails, hanging like clustered aerial roots, are visible from below. A tall mangc, and a *Lagerstroemia lanceolata* in thick leaf were the trees selected in the instances observed, and if a tall tree in leaf is available, it is chosen (TN 64 March 30; MR 68 November 25, 26; 69 November 19, 20, 26). Prater mentions that a troop returns to the same roosting tree night after night; this has not been my experience.

In the Taroba N.P. I noticed that an iora had built its nest in the mango tree in which the langur roosted, and a number of roseringed parakeets were also roosting in the top branches, and they seemed in no way affected by the violent shaking to which the langur subjected the tree. Langur seem to be late risers and the roosting party watched in Taroba did not descend till 7 a.m. : prior to descent, too, the tree is shaken.

When it rains langur seek the shelter of trees with leafy crowns, especially when there are young in the party. During sustained downpours, when the drip from the leaves is heavy, they continue to stay in treetops, in huddled immobile groups, some of them little protected by the canopy, with the rainwater cascading from their pendent tails. When the rains stops, they shake themselves like wet dogs, and bound about the larger branches not too energetically to dry themselves—considering that the wet surfaces of these branches are prone to be slippery, this restraint on their exuberance is understandable (TN 66 April 11 & 18).

The violent shaking of boughs and foliage, and the display of teeth in a silent snarl, are the main intimidatory gestures. The tail is highly expressive in repose and action. While sitting in a tree in repose, it hangs straight down, at times loosely draped around a branch below, and while resting on the forest floor is laid full length along the ground. Moving at leisure on the ground, it is often trailed, and when walking faster or running, is elevated, with the distal half pendent in a bold loop or flowing behind, depending on the pace of the animal: when about to take a leap, the tail is often raised high and flung so far forward that the tip is above the head of the monkey (Photographs: MP 8; MR 1).

The two main vocalisations, the normal, loud, joyous-sounding whoops and the repeated, frenzied swearing at the sight of a predator,

have been described by many observers. Regarding the latter, it may be said that it seems to be a compulsive instinctive response to the sight of danger or suspected danger, and also an expression of aggressive intent; as remarked by all observers, it is sustained only so long as the object of alarm or hatred is in sight. It is indulged in from a treetop or similar elevated stance—langur on the ground run away in silence when a predator approaches, and it is significant that on such occasions their run is much less exuberant than usual, more of a hasty sneaking away than a bounding along, and that the ground is not slapped sharply by the palms and soles. In spite of its keen daytime vision (the main perceptive faculty of the monkey) it swears not only at a live predator but also at the carcass of a leopard or tiger being carried through the forest, and also at any object reminiscent of the pelage of the dreaded predators, the swearing being an instinctive, and not a reasoned response. Years ago, while proceeding in an open jeep along a forest road in Ramgad in Sandur, our passage was marked by the vociferous swearing of every group of langur up trees we passed, which swore hysterically at my wife, who was wearing a saree with a chrome yellow ground patterned with black in a somewhat pantherine pattern! Bonnet monkeys seem more discriminate in swearing at predators.

During such vocal demonstrations, langur violently agitate the treetops they are in. Both the frenzied swearing and the agitation of boughs and foliage is freely indulged in during aggressive displays between adult males (MY 68 Oct. 7, 13 & 18).

Subadults indulging in rough-and-tumbles screech and squeal. A fear-call oftener heard from very young langur than from adults is a low, tremulous whimper.

Grooming activity is similar to that of other monkeys. A display of affection by hugging the object of affection is also noticeable in this monkey, as already detailed, and is probably a common feature of the behaviour of all primates.

Like other langurs, it is a strict vegetarian in its diet. Twice, grey langur were observed snatching at swarming termites issuing from the earth after early summer rains (TN 62 March 15, 66 April 18). These were probably aberrant specimens, and if they were not, their haphazard, fumbling attempts at catching the winged insect in the air seemed good evidence of their vegetarianism.

The most notable thing about their feeding habits is that unlike other Indian monkeys, their gregariousness while feeding is not almost exclusively intraspecific. At times rhesus and bonnet macaques may unwillingly share pickings with other animals, as with dogs at railway stations; they are then scavenging in competition with other animals rather than feeding in company with them, and it is not mutual tolerance but a fear of each other that sustains the uneasy truce between them, and even